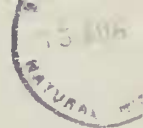


MIDDLE JURASSIC OSTRACODA FROM
NORTH LINCOLNSHIRE



BY

RAYMOND HOLMES BATE, Ph.D.

Pp. 173-219; 15 Plates; 15 Text-figures

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
GEOLOGY Vol. 8 No. 4
LONDON: 1963

THE BULLETIN OF THE BRITISH MUSEUM
(NATURAL HISTORY), *instituted in 1949, is
issued in five series corresponding to the Departments
of the Museum, and an Historical Series.*

*Parts will appear at irregular intervals as they become
ready. Volumes will contain about three or four
hundred pages, and will not necessarily be completed
within one calendar year.*

*This paper is Vol. 8, No. 4 of the Geological (Pala-
eontological) series. The abbreviated titles of periodicals
cited follow those of the World List of Scientific
Periodicals.*

© Trustees of the British Museum, 1963

PRINTED BY ORDER OF THE TRUSTEES OF
THE BRITISH MUSEUM

Issued August 1963

Price Thirty-eight Shillings

MIDDLE JURASSIC OSTRACODA FROM NORTH LINCOLNSHIRE

By RAYMOND HOLMES BATE

CONTENTS

	Page
I INTRODUCTION	176
II ACKNOWLEDGEMENTS	177
III STRATIGRAPHY AND LOCATION	177
IV TERMINOLOGY	178
V CLASSIFICATION OF THE BAJOCIAN OSTRACODA	179
VI SYSTEMATIC DESCRIPTIONS	183
Order Podocopida Müller	183
Suborder Platycopina Sars	183
Family Cytherellidae Sars	183
Genus <i>Cytherella</i> Jones	183
<i>C. fullonica</i> Jones & Sherborn	184
Genus <i>Cytherelloidea</i> Alexander	184
<i>C. catenulata</i> (Jones & Sherborn)	184
Genus <i>Platella</i> Coryell & Fields	185
<i>P. jurassica</i> sp. nov.	185
Suborder Podocopina Sars	186
Superfamily Cypridacea Baird	186
Family Paracyprididae Sars	186
Genus <i>Paracypris</i> Sars	186
<i>P. bajociana</i> sp. nov.	186
Superfamily Bairdiacea Sars	187
Family Bairdiidae Sars	187
Genus <i>Bairdia</i> McCoy	187
<i>B. hilda</i> Jones	188
Superfamily Cytheracea Baird	189
Family Bythocytheridae Sars	189
Genus <i>Monoceratina</i> Roth	189
<i>M. vulsa</i> (Jones & Sherborn)	189
<i>M. sp. cf. M. scrobiculata</i> Triebel & Bartenstein	190
Family Progonocytheridae Sylvester-Bradley	191
Subfamily Progonocytherinae Sylvester-Bradley	191
Genus <i>Progonocythere</i> Sylvester-Bradley	191
<i>P. cristata</i> sp. nov.	191
Genus <i>Pneumatocythere</i> nov.	193
<i>P. bajociana</i> sp. nov.	193
Genus <i>Acanthocythere</i> Sylvester-Bradley	195
Subgenus <i>Protoacanthocythere</i> nov.	195
<i>A. (P.) faveolata</i> sp. nov.	195
Genus <i>Fuhrbergiella</i> Brand & Malz	197
Subgenus <i>Praefuhrbergiella</i> Brand & Malz	197
<i>F. (P.) arens</i> sp. nov.	197

Genus <i>Aulacocythere</i> nov.	198
<i>A. punctata</i> sp. nov.	199
<i>A. reticulata</i> sp. nov.	200
Genus <i>Camptocythere</i> Triebel	201
<i>C. lincolnensis</i> sp. nov.	201
Subfamily Pleurocytherinae Mandelstam	203
Genus <i>Pleurocythere</i> Triebel	203
<i>P. kirtonensis</i> sp. nov.	203
<i>P. nodosa</i> sp. nov.	204
Family Cytherideidae Sars	205
Subfamily Cytherideinae Sars	205
Genus <i>Dolocythere</i> Mertens	205
<i>D. maculosa</i> sp. nov.	205
Family Schulerideidae Mandelstam	207
Subfamily Schulerideinae Mandelstam	207
Genus <i>Praeschuleridea</i> nov.	207
<i>P. subtrigona</i> (Jones & Sherborn)	207
Family Protocytheridae Ljubimova	209
Subfamily Kirtonellinae nov.	209
Genus <i>Kirtonella</i> nov.	209
<i>K. plicata</i> sp. nov.	210
Genus <i>Systemocythere</i> nov.	211
<i>S. exilofasciata</i> sp. nov.	212
Genus <i>Ektyphocythere</i> nov.	213
<i>E. triangula</i> (Brand)	214
Family Loxoconchidae Sars	216
Genus <i>Cytheromorphora</i> Hirschmann	216
<i>C. (?) greetwellensis</i> sp. nov.	216
VII REFERENCES	216

SYNOPSIS

The Bajocian Ostracoda from the Lincolnshire Limestone are described. In a few instances Yorkshire material has been utilized to give a more complete description to some of the Lincolnshire species. They comprise nine families divided into two suborders: Platycopina (one family), Podocopina (eight families). The subfamilies *Pleurocytherinae* and *Schulerideinae* are re-introduced, the subfamilies, *Protocytherinae* and *Schulerideinae*, are given family status, and a new subfamily *Kirtonellinae*, is described. Of the nineteen genera, two subgenera and twenty-two species discussed, six genera, one subgenus and fifteen species are new. The classification of the ostracods belonging to the superfamily Cytheracea is discussed with reference to the Bajocian ostracods. The importance of shape, muscle scars and radial pore canals in this classification is stressed. The variation in the arrangement of the muscle scars has led to the introduction of four types (A-D). A new ostracod hinge, termed *paleohemimerodont*, is described.

INTRODUCTION

THIS is the first of several papers to be published concerning the marine Middle Jurassic Ostracoda of Yorkshire and Lincolnshire. Not only is there no published work on the Bajocian ostracods of this country, but there has been a general neglect of their study elsewhere. The large number of new genera and species described in the text is a direct reflection of this neglect.

Whilst examining the Bajocian ostracods, morphological details of the carapace

have yielded important information concerning the classification of the ostracod genera (within the Cytheracea) and this suggests that characters at present used to group ostracods at levels higher than the genus should be reviewed. In this respect the importance of the ostracod hinge in the current classification (Moore, 1961) is considered to be out of all proportion to its true value.

As shown by Sylvester-Bradley (1956), the ostracod hinge evolves throughout the Mesozoic, unrelated ostracods often exhibiting identical hinge structures at varying stages in their evolution. Amongst the ostracods examined the simplicity of the duplicature and of the radial pore canals suggests that these structures were developing at a much slower rate than that exhibited by the hinge. As a result, the influence of these two structures on the classification is not strong in the Bajocian.

As there appears to be some variance amongst Jurassic workers as to the precise ammonite zones which go to make up the divisions of the Bajocian Stage, it is proposed to follow Arkell (1956).

All the ostracods described in the present paper are deposited in the collections of the British Museum (Natural History), within the Department of Palaeontology.

ACKNOWLEDGEMENTS

The author is indebted to Professor L. R. Moore of Sheffield University in whose department the work embodied in this paper was commenced. The encouragement and guidance so freely given by Professor P. C. Sylvester-Bradley whilst at Sheffield and latterly at Leicester University is also gratefully acknowledged. Dr. C. G. Adams, British Museum (Natural History), kindly made available material collected by himself from the *A. crossi* bed, Kirton Lindsey. The loan of type and comparative material from the following is also recorded: Niedersächsisches Landesamt für Bodenforschung, Hannover (Dr. B. Moos); Smithsonian Institution, United States National Museum, Washington (Dr. G. A. Cooper); Professor P. C. Sylvester-Bradley, Leicester University and Dr. H. V. Howe, Louisiana State University. Dr. H. Dighton Thomas critically read the manuscript. The author also acknowledges the receipt of a D.S.I.R. Research Studentship Grant which made this investigation possible.

STRATIGRAPHY AND LOCATION

Ammonites are rarely found in the Middle Jurassic sediments of north-eastern England, and exact age determinations of these beds are difficult. Kent & Baker (1937) record the few ammonites which have been found in the Lincolnshire Limestone and these all occur in the lower 12 ft. This lower division of the Lincolnshire Limestone can be dated accurately on the ammonite evidence as *discites* in age. Arkell (1933: 214) records the presence of *Trigonia hemisphaerica* Lycett in the marly bed situated between the Hibaldstow Oolite¹ and the Kirton Cementstone Series in the region of Kirton Lindsey. This marly bed is the *Acanthothiris crossi* bed from which many of the ostracods described in this paper have been obtained. Arkell notes that this particular species of *Trigonia* is found in the Cotswolds only in the

¹ The Cave and Millepore Oolites referred to in the text are most probably to be correlated with this bed.

Lower Trigonía Grit, a bed of *discites* age. The exact age of the remaining part of the Upper Lincolnshire Limestone is still uncertain. If we consider the *A. crossi* bed to be *discites* in age as suggested by Arkell, it follows that all the ostracods described in this paper are from this single ammonite zone.

A full account of the geology of the Lincoln district is given by Evans (1952), from whom the following succession is adapted :—

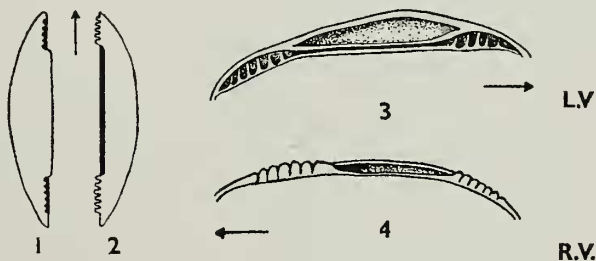
	Thickness in feet
Cornbrash	3-4
Blisworth Clay	20-23
Gt. Oolite Limestone	19-24
Upper Estuarine Series	23-28
Upper Lincolnshire Limestone	
Hibaldstow Oolite	35-50
<i>A. crossi</i> Bed	10-12
Lower Lincolnshire Limestone	
Kirton Cementstone Series	8-12
Blue and Silver Beds	10-12
Lower Estuarine Series	0-4
Northampton Sand	8-12
Lias	85-90

The Lower Lincolnshire Limestone consisting of the Blue and Silver Beds and the Kirton Cementstone Series is perfectly exposed at Greetwell Quarry, due east of Lincoln (map reference TF/002725), where bed by bed sampling was undertaken. The *A. crossi* bed was not exposed in the Greetwell Quarry when the section was examined, although 1 ft. of grey marl at the top of the succession, faunally and lithologically identical with the *A. crossi* bed at Kirton Lindsey, may represent it. Because of the excellence of the material the ostracod fauna of the *A. crossi* bed is described from the Kirton Lindsey section (Kirton Cement Quarry, map reference SE/942011), which was sampled by Dr. C. G. Adams. The Upper Lincolnshire Limestone, apart from the *A. crossi* bed, has so far proven to be almost lacking in ostracods and is not dealt with here. The two localities mentioned in the text, from which additional Bajocian material has been included in this paper are :—Yons Nab headland, Cayton Bay (for the Yons Nab Beds), map reference TA/084844, and Eastfield Quarry, South Cave (for the Cave Oolite and the marl bed beneath), map reference SE/913323. Both localities are in Yorkshire and will be dealt with in more detail in the forthcoming publications.

TERMINOLOGY

Terminology concerning the ostracod carapace used in this paper follows that put forward in the *Treatise on Invertebrate Paleontology* (Moore, 1961), with additional hinge terminology (dentate, denticulate, loculate and locellate) taken from Sylvester-Bradley (1956). Where dimorphism has been observed in a species (based on a height : length ratio), the more elongate specimens are regarded as being the males, whilst the shorter specimens are considered to be the females.

A considerable variation exists in the type of hinge exhibited amongst the podocopid ostracods. As a result it has been found convenient to name each distinct type (Moore, 1961 : 31-36). Among the species of the new genus *Praeschuleridea*, of which only a single species is described in the present paper, a characteristic hinge is present which is not typically paleomerodont, although at first glance it appears to be so. That type of hinge commonly attributed to the genus *Schuleridea* Swartz and Swain (Triebel, 1954), consists of terminal sockets connected by a median groove in the left valve and terminal teeth connected by a median bar in the right valve, the median bar projecting beyond the hinge line when viewed dorsally. In the hinge of *Praeschuleridea*, however, it is the median element of the left valve which projects beyond the hinge line. In this respect the hinge is typically merodont and in possessing terminal loculate/dentate elements and smooth median elements conforms to the type known as hemimerodont. However, the terminal sockets of the left valve are united across the median bar by a smooth groove. In the right valve a low ridge connects the dentate terminal elements. The hinge is therefore partially hemimero-



FIGS. 1-4. Paleohemimerodont hinge. FIGS. 1, 2. Dorsal view of left and right valves : note projection of median bar in the left valve beyond the hinge line. FIGS. 3, 4. Lateral views, left and right valves.

dont and partially paleomerodont, for which the term *Paleohemimerodont* is here proposed (Text-Figs. 1-4).

CLASSIFICATION OF THE BAJOCIAN OSTRACODA

The classification proposed in the *Treatise on Invertebrate Paleontology* (Moore, 1961) is not satisfactory when dealing with the Bajocian ostracods belonging to the superfamily Cytheracea. Indeed the emphasis placed upon hinge structures as a basis for the classification is admitted to result in a purely artificial grouping. The present study has shown that hinge structures are by no means the best form of classifying these animals above the level of a genus.

Although workers such as Gocht & Goerlich (1957) have isolated appendages from fossil ostracod carapaces, it is unlikely that the classification of fossil ostracods will ever follow similar lines to that adopted by zoologists. It will therefore be necessary to look elsewhere for morphological details to provide the taxonomist with the means for developing a more natural classification. The importance of muscle scars, radial pore canals and of the duplicature are recognized in the *Treatise*, but are not

utilized to the full. However, taken in conjunction with general shape (including such functional structure as alae, etc. . . . which are not purely ornamental), these are considered to be of prime importance in the determination of family and subfamily taxa.

The development of such structures as radial pore canals and the duplicature appears to have lagged behind that of the hinge in the evolution of the Cytheracea. An equivalent, well advanced stage of development appears in the muscle scars, which give the impression that these are much more fundamental than the others mentioned above. Their diversity is probably reflected in the appearance of higher taxa (families and subfamilies) in the Bajocian. The development of the numerous genera which occur in the Bajocian sediments commenced in many cases in Liassic times, but there appears to have been a distinct increase in the number of new genera and species during the Bajocian.

The degree of variation shown by the antennal muscle scar(s) is of primary importance in the study of the Bajocian Cytheracea. Only slight variation occurs with respect to the adductor or mandibular scars. The variations exhibited by these centrally situated scars are of four distinct types, although not all these variations are found in the species described here. However, as this is the first of several connected papers, it is convenient to discuss the variations shown by the Bajocian ostracods as a whole.

Within the Cytheracea the basic arrangement consists of four adductor muscle scars situated in a vertical or subvertical row slightly anterior of the valve centre. In front of these scars lies an anterodorsal antennal and an anteroventral mandibular scar. Although it is possible to distinguish four main groupings of these scars it is important to be able to identify the variations which occur within a group. Any natural grouping of characters is almost certainly bound to show some degree of variation and the muscle scars are not without exception.

The position where the muscle fibres are attached to the inside of the carapace is marked by a small upraised spot. If the muscle fibres are attached as a single bundle, a single spot or scar results. However, in some cases, the single scar can be seen to be formed by the fusion of two scars, whilst in the others two distinct antennal scars exist. Both conditions can result either from the splitting of the muscle fibres or by the close proximity of two distinct antennal muscles. In either case there would appear to be only a limited degree of variability possible. It is this variability and the associated types which are discussed below.

Type A

This type approximates most closely to the typical cytheracean muscle scar arrangement in that the adductor scars are situated in a subvertical or vertical row with a single (occasionally two) rounded, anterodorsal antennal scar and a single rounded anteroventral mandibular scar. The antennal scar shows a degree of variation produced by the partial or complete division of the single scar. Complete separation naturally results in the appearance of two distinct scars. Both variants occur in the same species (Text-figs. 6, 7). Partial separation as shown to a slight degree in a single scar of *Pneumatocythere bajociana* sp. nov. results in the develop-

ment of a kidney-shaped scar. Species of *Progonocythere* are liable to possess either a rounded or a kidney-shaped antennal scar. In this type the antennal scar is usually situated anterodorsally, but may vary within a species and sometimes approach the anteromedian position.

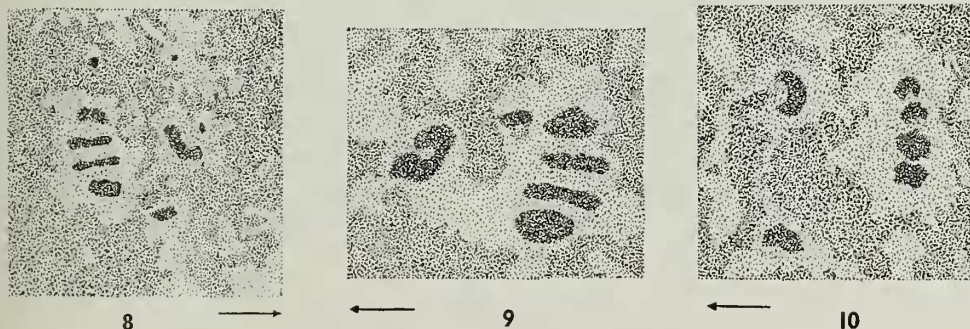


FIGS. 5-7. Type A muscle scar pattern. Fig. 5, *Progonocythere* sp. nov. $\times 250$.

Figs. 6 ($\times 300$), 7 ($\times 200$), *Progonocythere bajociana* sp. nov.

Type B

In a large number of ostracod genera the antennal scar is distinctly crescentic in outline, generally with the opening of the crescent directed anteriorly (Text-fig. 10). Possibly related is the condition where the antennal scar is directed obliquely anterodorsally, a condition somewhat akin to type D described below. The crescentic antennal scar is not considered to be related to the kidney-shaped scar of the previous type (A). A mandibular support spot ("mandibular stutzfleck" of Triebel) is commonly associated with this muscle scar type, and further research may prove this association to be significant.



FIGS. 8-10. Type B muscle scar pattern. Figs. 8 ($\times 200$), 9 ($\times 320$), *Dolococythere maculosa* sp. nov.

Fig. 10, gen. nov. $\times 240$

Type C

The most common position for the antennal scar, relative to the adductor scars, appears to be anterodorsal. Amongst several related Bajocian ostracod genera the

antennal scar is decidedly anteromedian in position. It may be either oval or kidney-shaped with a smaller scar in front. Possibly it is the fusion of these two scars which produces the single oval scar. A transitional stage as in type "A" has not been observed. A second feature of this particular type is the position of the adductor muscle scars. In the previous types these scars have formed a vertical or subvertical row on the inside of the valve, only rarely are they situated in a slightly curved row. In the type under discussion here, the adductor scars are distinctly grouped crescentically around the anteromedian antennal scar (Text-figs. 11, 15).

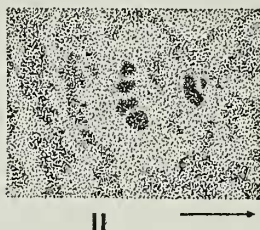
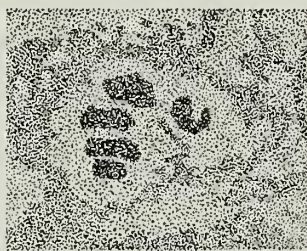


FIG. 11. Type C muscle scar pattern. *Praeschuleridea* sp. nov. $\times 150$

Type D

In many Bajocian ostracods the antennal scar is U- or V-shaped with the opening of the scar directed dorsally. The antennal scar may be either anterodorsal or anteromedian in position with the adductor scars in a subvertical row behind, (Text-figs. 12, 13).



FIGS. 12, 13. Type D muscle scar pattern. Fig. 12, *Kirtonella plicata* sp. nov. $\times 320$
Fig. 13, *Ektyphocythere triangula* (Brand). $\times 220$

The mandibular scars show little variation and at the present are not considered to have any distinct role in the ostracod classification.

The variation indicated for the four types of muscle scar arrangement is not exhaustive, although it seems unlikely that any other major group will be found in

the Middle Jurassic ostracods. Evidence so far available suggests that a genus possessing a U-shaped antennal scar should not be placed, for example, in the same family grouping as those possessing a rounded antennal scar. However, it is important that muscle scars should not be used alone in identifying family and subfamily taxa—rather they should be used in conjunction with other characters.

At the moment little is known concerning the importance of the small group of dorsal scars which often occur above the adductor scars (Pl. 12, fig. 10). Although these probably include additional antennal and mandibular scars, further research is required before any definite statements can be made about them.

The radial pore canals in the cytheracean ostracods studied here are simple, generally short and straight, and widely spaced around the anterior and posterior margins. Their importance in the classification lies in their association with other morphological characters, and it is probably only the anterior canals which are of value in this connexion. All related ostracod genera in the Bajocian sediments of north-east England, possess similar radial pore canals, the only variation being in the number present. A basic pore canal arrangement is therefore considered to indicate subfamily or family relationship when taken in conjunction with other characters. In *Schuleridea* Swartz & Swain, *Asciocythere* Swain, and *Praeschuleridea* gen. nov. (here all considered to belong to the same family), the radial pore canals are arranged fan-like around the anterior margin, the only variation being numerical.

The duplicature in the Bajocian ostracods tends to be simple, with the line of concrescence and inner margin coinciding.

In conclusion, the following are considered important in the ostracod classification :

Shape, hinge features, muscle scars, radial pore canals (and associated duplicature), and the presence or absence of an eye tubercle (an eye node and an eye swelling being similar ocular structures but having less prominence on the carapace) are all considered to be important characters in the diagnosis of a genus. For higher taxa all the foregoing characters are of importance with the exception of the hinge and the ocular structures. The three genera quoted previously may be used again in this context : *Asciocythere*, *Schuleridea* and *Praeschuleridea* are three distinct genera possessing different hinge structures but having a similar outline, the same type of muscle scar arrangement, and radial pore canals arranged fan-like around the anterior margin. All three belong to the same family. The characters used above to relate them are emphasized in the classification of the ostracods in the present paper.

SYSTEMATIC DESCRIPTIONS

Subclass **OSTRACODA** Latreille, 1806

Order **PODOCOPIDA** Müller, 1894

Suborder **PLATYCOPINA** Sars, 1866

Family **CYTHERELLIDAE** Sars, 1866

Genus **CYTHERELLA** Jones, 1849

DIAGNOSIS. A genus of Cytherellidae, oval to subrectangular in outline, without ornamentation. A shallow dorsomedian depression. Right valve larger than left.

TYPE SPECIES. *Cytherina ovata* Roemer, 1840.

Cytherella fullonica Jones & Sherborn

(Pl. 1, figs. 1, 2)

1888. *Cytherella fullonica* Jones & Sherborn, p. 274, pl. 1, fig. 12a-c.

DIAGNOSIS. A subrectangular species of *Cytherella* with an obliquely angled posterodorsal slope.

LECTOTYPE. (chosen here) I. 1857a, a single left valve, figd., Jones & Sherborn, 1888, pl. 1, fig. 12a-c, Blue Fuller's Earth Clay, Midford nr. Bath.

PARALECTOTYPE. I. 1857b, a single left valve, horizon and locality as above.

DESCRIPTION. *Carapace* subrectangular in outline, the right valve being larger than the left which it overlaps on all sides except around the anterior margin. Greatest length through midpoint, greatest height in the anterior third whilst the greatest width is in the posterior third. Anterior broadly rounded, posterior obliquely rounded, dorsal margin slightly concave medially with rounded cardinal angles. The posterodorsal slope is long and obliquely sloping to the posterior. Ventral margin medially concave. Surface of carapace smooth with shallow dorsomedian depression marking position of muscle scars, internally situated on muscle scar node. Internally the right valve has a groove extending around the free margin for reception of the left valve.

Dimensions

Io. 522 left valve, length 0.69 mm.; height 0.35 mm. Io. 520 right valve (Pl. 1, figs. 1, 2), length 0.71 mm.; height 0.39 mm.

REMARKS. Over 100 specimens of this species have been examined from the Middle Bajocian, Kirton Shale, Kirton Lindsey and from the Kirton Cementstone Series; Greetwell Quarry, Lincoln.

Genus *CYTHERELLOIDEA* Alexander, 1929

DIAGNOSIS. A genus of Cytherellidae, subrectangular in outline variously ornamented with ridges and swellings. Right valve larger than left.

TYPE SPECIES. *Cytherella williamsoniana* Jones, 1849.

REMARKS. Placed as a subgenus of *Cytherella* by Reyment (1960), but considered here as a distinct genus.

Cytherelloidea catenulata (Jones & Sherborn)

(Pl. 1, figs. 3-6)

1888. *Cytherella catenulata* Jones & Sherborn, p. 274, pl. 5, fig. 6a-c.1948a. ? *Cytherelloidea catenulata* (Jones & Sherborn) Sylvester-Bradley, p. 200, pl. 14, fig. 11, text-fig. 7.

DIAGNOSIS. A species of *Cytherelloidea* with crescent-shaped swelling situated close to posterior margin of valve. Dorsal limb of crescent bending over and curving forwards close to ventral margin to produce a swelling shaped like a question mark.

LECTOTYPE. (chosen here) I. 1876, a single left valve, fig., Jones & Sherborn, 1888, pl. 5, fig. 6a-c. Fuller's Earth Clay, Midford nr. Bath.

PARALECTOTYPES. I. 1846 and Io. 796 a left and right valve. Horizon and locality as above.

DESCRIPTION. *Carapace* subrectangular in outline with a prominent posterior swelling shaped like a question mark. Shell surface ornamented with a reticulate pattern of very fine ridges. Depending on preservation this latter ornamentation may be almost imperceptible. Greatest length of carapace passes through midpoint with the greatest height in the anterior or posterior third. Greatest width in the posterior third. Dorsal margin of both valves slightly concave in the anterior half, becoming strongly convex just behind valve middle. Cardinal angles broadly rounded. Posterodorsal slope oblique. Ventral margin medially concave. Anterior broadly rounded, posterior rounded tending to be rather flattened terminally. Right valve larger than the left which it overlaps on all sides except around the anterior margin where the right valve merely overreaches the left. A dorsomedian depression marks the position of the muscle scars, which (as imperfectly seen) are typical of the family.

Dimensions

Io. 524. left valve (Pl. 1, figs. 3, 5), length 0.75 mm; height 0.37 mm. Io. 525 right valve (Pl. 1, figs. 4, 6), length 0.79 mm; height 0.44 mm.

REMARKS. 50 specimens of *C. catenulata* have been obtained from the Kirton Shale, Kirton Lindsey and from the Kirton Cementstone Series, Lincoln.

Genus *PLATELLA* Coryell & Fields 1937

DIAGNOSIS. A genus of Cytherellidae, oval to subrectangular in outline, finely or coarsely pitted, with shallow dorsomedian sulcus. Right valve larger than left.

TYPE SPECIES. *Platella gatunensis* Coryell & Fields, 1937.

Platella jurassica sp. nov.

(Pl. 1, figs. 7-10)

DIAGNOSIS. A species of *Platella* strongly ovoid in outline with arched dorsal margin and strongly concave ventral margin. Surface of carapace typically ornamented with a reticulate pattern of small pits arranged in rows, rows paralleling sides of carapace.

HOLOTYPE. Io. 526, Kirton Shale, Kirton Cement Quarry, Kirton Lindsey.

PARATYPES. Io. 527, Io. 797-98, horizon and locality as above.

DESCRIPTION. *Carapace* ovoid in outline with a strongly arched dorsal margin and a strongly concave ventral margin. Anterior broadly rounded with a narrow compressed rim, posterior rather obliquely rounded. Carapace characteristically ornamented with a reticulate pattern of small pits arranged in rows paralleling the sides of the carapace. Greatest length through midpoint, greatest height in

the anterior third, whilst the greatest width is just behind valve centre. Right valve larger than the left, which it overlaps along the dorsal and ventral margins but not around the anterior and posterior margins. A distinct dorsomedian pit marks the position of the muscle scars. Internal details not known.

Dimensions

HOLOTYPE. Io. 526 carapace (Pl. 1, figs. 7-10), length 0.64 mm. ; height 0.37 mm. ; width 0.23 mm.

PARATYPE. Io. 527 right valve, length 0.43 mm. ; height 0.28 mm.

REMARKS. This species differs from the Miocene *P. gatunensis* Coryell & Fields (1937, Text-fig. 2a, b) in the possession of a more strongly concave ventral margin and in the smaller size of the pits. Only a few specimens of this species have been found from Kirton Lindsey and apart from the two described, were poorly preserved.

Suborder **PODOCOPINA** Sars, 1866

Superfamily **CYPRIDACEA** Baird, 1845

Family **PARACYPRIDIDAE** Sars, 1923

Genus **PARACYPRIS** Sars, 1866

DIAGNOSIS. An elongate genus of the Paracyprididae, posteriorly acuminate. Dorsal margin arched, ventral margin incurved. Anterior and posterior vestibules well developed, anterior radial pore canals branching. Muscle scars an oblique row of three scars with two or more behind. Left valve larger than right.

TYPE SPECIES. *Paracypris polita* Sars, 1866.

Paracypris bajociana sp. nov.

(Pl. 2, figs. 1-8)

DIAGNOSIS. Carapace sub-reniform, dorsal margin strongly convex. Left valve overlapping the right along antero-, and posterodorsal slopes. Anterior and posterior cardinal angles not strongly developed. Ventral margin slightly concave. Greatest length ventral of midpoint. Anterior radial pore canals branching and evenly spaced.

HOLOTYPE. Io. 528, Kirton Shale, Kirton Cement Quarry, Kirton Lindsey.

PARATYPES. Io. 529-33, Io. 694, Io. 799-802, horizon and locality as above, and from the marl bed below the Cave Oolite, Eastfield Quarry, South Cave.

DESCRIPTION. *Carapace* sub-reniform in outline, rather elongate. Anterior broadly rounded ; posterior tapering. Dorsal margin convex with a slight break at the anterior and posterior cardinal angles. Anteriorly there is a short antero-dorsal slope, whilst posteriorly there is a longer, much steeper slope which extends down to the extreme posterior, close to the ventral margin. The latter more strongly concave in the right valve than in the left. Greatest height and width in the anterior third. Greatest length below midpoint. Shell surface smooth. Left valve larger

than the right, overlapping most strongly along the anterodorsal and posterodorsal margins and midventrally with only slight overlap around the anterior margin. *Muscle scars* as seen from the exterior consist of an oblique row of three oval scars with two other scars behind. *Radial pore canals* long, branching anteriorly, straight posteriorly. Anteriorly the pore canals are evenly spaced around the margin, in which character they appear to differ from the type species: *Paracypris polita* Sars. Anteriorly there are 6–10 rather thick, main canals which terminally split up into 2, 3, or more fine, hair-like canals. Posteriorly the canals are unbranched and are approximately 10 in number. *Inner margin* and *line of concrescence* do not coincide terminally, an anterior and posterior vestibule being developed. The selva is prominent around the free margin. The *hinge* consists of a simple, long, straight groove in the left valve into which the dorsal edge of the right valve fits.

Dimensions

HOLOTYPE. Io. 528 carapace (Pl. 2, figs. 1, 3, 4), length 0.60 mm.; height 0.28 mm.; width 0.23 mm.

PARATYPES

Io. 529 left valve (Pl. 2, fig. 2) length 0.61 mm.; height 0.27 mm.

Io. 530 left valve (Pl. 2, fig. 7) length 0.56 mm.; height 0.25 mm.

Io. 531 left valve length 0.60 mm.; height 0.25 mm.

Io. 532 left valve (Pl. 2, figs. 5, 6) length 0.59 mm.; height 0.27 mm.

Io. 533 left valve (Pl. 2, fig. 8) length 0.57 mm.; height 0.25 mm.

Io. 694 right valve length 0.60 mm.; height 0.25 mm.

REMARKS. *P. bajociana* resembles *P. projecta* (Peterson, 1954, Pl. 17, figs. 14, 15) but differs in having a much stronger overlap of the right valve by the left along the antero- and posterodorsal slopes. The Tertiary *P. aerodynamica* (Oertli, 1956, pl. 1, figs. 24–26, 28–30) is similar in shape, but differs in size (length 1.01 mm.–1.19 mm.) and in its more strongly branching anterior radial pore canals. *P. bajociana* is a common ostracod within the marine Middle Bajocian sediments of Lincolnshire and Yorkshire.

Superfamily BAIRDIACEA Sars, 1888

Family BAIRDIIDAE Sars, 1888

Genus BAIRDIA McCoy, 1844

DIAGNOSIS. A genus of Bairdiidae elongate to subtriangular in outline. Dorsal margin arched, antero- and posterodorsal slopes usually concave, sharply inclined. Ventral margin strongly convex antero-, and posteroventrally. Posterior acuminate, slightly upturned. Duplicature broad, vestibules well developed. Muscle scars in a rosette, approximately 9 in number. Left valve larger than right.

TYPE SPECIES. *Bairdia curtus* McCoy, 1844.

Bairdia hilda Jones

(Pl. 2, figs. 9-12; Pl. 3, figs. 1-4)

1884. *Bairdia hilda* Jones, p. 771, pl. 34, fig. 20.1888. *Bairdia fullonica* Jones & Sherborn, p. 253, pl. 5, fig. 4a-c.1948a. *Bairdia* cf. *hilda* Jones; Sylvester-Bradley, p. 199, text-fig. 5.

DIAGNOSIS. A species of *Bairdia*, subdeltoid in outline, strongly convex in dorsal view. Dorsal margin high, dorsal slopes steeply inclined. Posterior acuminate, upturned. Shell surface finely punctate.

LECTOTYPE. IN. 41951, a single left valve figd. Jones, 1884, pl. 34, fig. 20, Gt. Oolite; Richmond Boring, (London) at a depth of 1205 feet.

DESCRIPTION. *Carapace* subdeltoid in side view. Surface smooth with extremely fine puncta. Left valve larger than the right which it strongly overlaps midventrally and along the dorsal margin, particularly in the region of the cardinal angles. Anteriorly there is no overlap, posteriorly there may be very slight overreach along the posteroventral margin. Although the specimens vary slightly, the general outline is similar for all the specimens examined. Dorsal margin convex in the left valve, straight or very slightly convex in the right. Ventral margin strongly concave in the right valve, only slightly concave in the left, the latter being overhung by the ventrolateral border. Anterior rounded with a distinct anterodorsal slope; straight or slightly convex in the left valve, concave in the right. Posterior margin convex posteroventrally, although the degree of convexity varies in individual specimens. Posterodorsal margin straight, upturned at extreme posterior, more sharply pronounced in the right valve. Anterior and posterior cardinal angles sharply defined. *Muscle scars* consist of a rosette of 8 scars with a single central scar (Pl. 3, fig. 4). The downset dorsal edge of the right valve forms the hinge by fitting into the shallow groove of the left valve, the groove being terminally deepened to form socket-like terminations. Dorsal to this groove is an elongate shelf-like accommodation groove. *Inner margin* and *line of concrescence* terminally do not coincide, the vestibules being particularly well developed along the anteroventral and posteroventral margins. The selvage is distinct around the free margin, obliquely cutting across the anterior and posterior borders. In well preserved specimens a broad flange is developed around the posteroventral and anteroventral margins.

Dimensions

Io. 534 internal cast (Pl. 3, fig. 4), length 0.93 mm.; height 0.53 mm.; width 0.53 mm.

Io. 535 carapace (Pl. 2, figs. 9, 11, 12), length 0.99 mm.; height 0.56 mm.; width 0.43 mm.

Io. 536 left valve (Pl. 3, figs. 2, 3), length 0.99 mm.; height 0.56 mm.

Io. 537 right valve (Pl. 2, fig. 10, pl. 3, fig. 1), length 0.95 mm.; height 0.49 mm.

REMARKS. The specimen described by Jones (1884) as *B. hilda* and by Jones & Sherborn (1888) as *B. fullonica* were regarded as conspecific by Sylvester-Bradley (1948a), when he showed a range of variation between the two. This is in agreement

with the present work, as the specimens described do not fall definitely into *B. hilda* or *B. fullonica*, but have characters which may be found in either. The specimens described here are abundant in the Middle Bajocian Kirton Shale, Kirton Lindsey and in the Kirton Cementstone Series, Lincoln.

Superfamily **CYTHERACEA** Baird, 1850

Family **BYTHOCYTHERIDAE** Sars, 1926

Genus **MONOCERATINA** Roth, 1928

DIAGNOSIS. A subrectangular genus of Bythocytheridae. Dorsal margin long and straight, terminating in a slight caudal process. Right valve with dorsal groove for reception of hinge bar of the left. Median sulcus shallow with a prominent swelling below and behind, sometimes bearing a strong spine. Muscle scars an oblique row of 4 or 5 scars.

TYPE SPECIES. *Monoceratina ventrale* Roth, 1928.

Monoceratina vulsa (Jones & Sherborn)

(Pl. 3, figs. 5-12)

1888 *Cytheridea vulsa* Jones & Sherborn, p. 263, pl. 2, fig. 4a-b.

1938 *Monoceratina vulsa* (Jones & Sherborn) Triebel & Bartenstein, p. 516, pl. 3, figs. 17, 18.

?1955 *Bythocythere aliena* Ljubimova, p. 34, pl. 2, fig. 3a-b.

1960 *Monoceratina cf. vulsa* (Jones & Sherborn); Lutze, p. 433, pl. 37, fig. 5a-b.

DIAGNOSIS. A strongly convex species (in dorsal view) of *Monoceratina* distinctly ornamented with elongate pits, the latter producing low irregular ridges.

LECTOTYPE. (chosen here) I. 1842, a single left valve figd. Jones & Sherborn, 1888, pl. 2, fig. 4a-b. Gt. Oolite; Richmond Boring (London) at a depth of 1205 feet.

DESCRIPTION. *Carapace* subquadrate in side view with a broad posteroventral border. In dorsal view, almost parallel-sided, diverging slightly to the posterior. Sexual dimorphism suggested by the presence of a more elongate specimen, possibly the male. Hinge line straight, terminating at the anterior cardinal angle in a small node, reminiscent of an eye swelling. Ventral margin slightly convex. Anterior uniformly rounded, posterior acuminate, produced by a long, oblique, strongly convex posteroventral slope and a short, slightly concave posterodorsal slope. Carapace strongly convex, divided into two subequal lobes by a vertical median sulcus. The anterior lobe, in dorsal view, is not so enlarged as is the posterior lobe and is uniformly rounded anteriorly. The posterior lobe follows the outline of the carapace in having a strong posteroventral upward sweep, at the extreme posteroventral corner of which there is a prominent swelling. A short longitudinal furrow, most strongly developed in the supposed male dimorph, bisects the posterior border along the line of greatest length, the latter being dorsal of midpoint. Greatest height just behind valve middle, greatest width below and posterior of the median sulcus. Valves almost equivalve, although the left valve slightly overlaps the right at the

centre of the ventral margin and at the posterior cardinal angle. A distinct postero-ventral keel is produced by the shelf-like marginal border, continued ventrally as a slight ridge. The anterior marginal border is thus continuous with the postero-ventral border along the ventral margin. Shell surface entirely covered by distinct pits producing low, irregular ridges, the whole appearing wrinkled. *Internal characters* only observed in the lectotype where the duplicature is broad and the hinge bar can be seen to be produced by the downset dorsal margin of the valve.

Dimensions

Io. 539 female? carapace (Pl. 3, figs. 5, 6, 8, 10), length 0.65 mm. ; height 0.33 mm. ; width 0.33 mm.

Io. 540 male? carapace (Pl. 3, figs. 7, 9, 11, 12), length 0.68 mm. ; height 0.32 mm. ; width 0.23 mm.

REMARKS. 38 specimens (all complete carapaces) have been recovered from the Kirton Shale, Kirton Lindsey, and the Kirton Cementstone Series, Lincoln.

Monoceratina sp. cf. *M. scrobiculata* Triebel & Bartenstein

(Pl. 4, figs. 1-4)

DESCRIPTION. *Carapace* elongate quadrate. Dorsal margin long and straight ventral margin short, paralleling the dorsal margin. Anterior broadly rounded, posterior acuminate, broadly triangular. Posterodorsal slope short and slightly concave in the left valve, slightly convex in the right, posteroventral slope long and straight. Anterior and posterior margins compressed. Surface of carapace covered with small pits. At the posteroventral border of each valve a prominent inflation projects strongly downwards and backwards. Valves convex with a vertical median sulcus dividing the carapace into two lobes of which the posterior is the most strongly developed. Greatest length dorsal of midpoint, greatest height in the anterior third, greatest width in the posterior third. A "V" shaped flattened area is present on the ventral surface, delimited laterally by the posteroventral projections. Medially along this flattened area a slight keel is produced by the overlap of the right valve by the left. This overlap along the ventral margin is the only overlap noticed in the specimens here described.

Dimensions

Io. 538 juvenile carapace. (Pl. 4, figs. 1-4.) length 0.28 mm. ; height 0.13 mm. ; width 0.13 mm. (+ ventrolateral extension).

REMARKS. The two specimens found in the Kirton Shale, Kirton Lindsey, are similar in some respects to *M. scrobiculata* Triebel & Bartenstein (1938, pl. 1, fig. 5a-b, pl. 2, fig. 6). As the best preserved specimen is a juvenile, exact identification with *M. scrobiculata* cannot be made.

Family **PROGONOCYTHERIDAE** Sylvester-Bradley, 1948

REMARKS. For diagnosis see Moore (1961 : Q322), where the family is, however, considered to be strictly artificial in that two subfamilies placed therein (Progonocytherinae and Protocytherinae), are simply groupings of ostracod genera related only by the possession of similar hinge structures. In the present paper the subfamily Protocytherinae is removed from the family and the subfamily Pleurocytherinae restored with subfamily rank. The importance of the hinge structure is no longer maintained for the family (or subfamilies), the artificial nature of which is considered to have been removed.

Subfamily PROGONOCYTHERINAE Sylvester-Bradley, 1948

EMENDED DIAGNOSIS. As for Malz, 1961 : 176, not Howe *in* Moore, 1961 : 326.

REMARKS. The ostracod genera included here are related by the following characteristics : carapace subquadrate in outline, often tapering to the posterior with a tendency for the ventrolateral part of the carapace to overhang the ventral surface. Internally the inner margin and line of concrescence coincide, there being no suggestion that a vestibule is present. The radial pore canals are straight and simple, few in number and widely spaced around the anterior and posterior margins. The muscle scars consist of a subvertical row of 4 rounded or oval adductor scars with an anterodorsal antennal scar which may be either rounded or weakly kidney-shaped. The mandibular scar is anteroventral in position and is also rounded. The muscle scar pattern is therefore of type A, as described previously (p. 180).

Genus **PROGONOCYTHERE** Sylvester-Bradley, 1948

EMENDED DIAGNOSIS. A subrectangular genus of Progonocytherinae, often strongly dimorphic. Carapace tapering posteriorly, dorsal margin noticeably angled in female dimorphs. Lateral border overhanging ventral surface. Shell variously ornamented. Hinge entomodont. Left valve larger than right.

TYPE SPECIES. *Progonocythere stilla* Sylvester-Bradley, 1948.

Progonocythere cristata sp. nov.

(Pl. 4, figs. 5-15 ; pl. 5, figs. 1-6)

DERIVATION OF NAME. Latin ; *cristatus*, crested.

DIAGNOSIS. A species of *Progonocythere* with strong keel-like extension of ventrolateral margin ; shell surface punctate ; anterior and posterior marginal areas compressed.

HOLOTYPE. Io. 543, Kirton Shale, Kirton Cement Quarry, Kirton Lindsey.

PARATYPES. Io. 544-50 and Io. 803-05, horizon and locality as above.

DESCRIPTION. *Carapace* oval in outline, rather swollen medially. Sexual dimorphism apparent, presumed males being the more elongate in outline. Dorsal

margin slightly convex, sloping to the posterior; cardinal angles distinct. Ventral margin convex; anterior broadly rounded, posterior triangular with a concave posterodorsal slope and a convex posteroventral slope. Anterior and posterior borders compressed. A slight swelling at the anterior cardinal angle is suggestive of an eye swelling. The ventrolateral margin of each valve projects strongly below the ventral surface in the form of a strong keel. Shell surface punctate, but depending on preservation may appear smooth. Ventral surface of each valve ornamented with about three longitudinal ridges. Weak longitudinal ridges occur in juvenile instars along the ventrolateral border; these are occasionally weakly developed in the adults. Left valve larger than the right, projecting strongly above the right along the dorsal margin, slightly overlapping the right valve midventrally. Greatest length through midpoint, greatest height in the anterior third, greatest width just posterior of valve centre. Hinge *entomodont*: right valve with terminal dentate ridges possessing 7 anterior and 7 posterior teeth; median groove strongly loculate, expanded anteriorly, the ventral edge of the expanded part being distinctly dentate. Left valve with terminal loculate sockets and a dentate median bar, more coarsely dentate anteriorly. Free margin formed by a prominent ridge (the selvage), external to which is a narrow flange, only clearly observable around the anterior and ventral margins. Midventrally a narrow "lip" is developed just below and posterior of the ventral incurvature in the right valve. *Inner margin* and *line of concrescence* coincide. *Radial pore canals* straight and widely spaced, approximately 8 anteriorly, not seen posteriorly. Muscle scars consist of a crescent of 4 oval adductor scars with a large, rounded anterodorsal antennal scar and a rounded anteroventral mandibular scar. Young instars possess antimerodont hinges.

Dimensions

HOLOTYPE. Io. 543 female carapace (Pl. 4, figs. 5-8) length 0.63 mm.; height 0.40 mm.; width 0.36 mm.

PARATYPES

Io. 544 male carapace (Pl. 4, figs. 9, 10) length 0.69 mm.; height 0.43 mm.; width 0.35 mm.

Io. 545 right valve male, (Pl. 5, fig. 5) length 0.71 mm.; height 0.44 mm.

Io. 546 left valve female (Pl. 4, fig. 11, Pl. 5, fig. 6) length 0.59 mm.; height 0.40 mm.

Io. 547 "juv." female carapace (Pl. 4, figs. 12, 13) length 0.44 mm.; height 0.15 mm.; width 0.27 mm.

Io. 548 "juv." male carapace (Pl. 4, figs. 14, 15, Pl. 5, figs. 3, 4) length 0.48 mm.; height 0.27 mm.; width 0.27 mm.

Io. 549 right valve male (Pl. 5, fig. 1) length 0.67 mm.; height 0.37 mm.

Io. 550 female carapace (Pl. 5, fig. 2) length 0.61 mm.; height 0.40 mm.; width 0.33 mm.

REMARKS. *Progonocythere cristata* differs from the type species, *P. stilla* Sylvester-Bradley (1948 pl. 12, figs. 1, 2, pl. 13, figs. 1, 2) in the possession of a sharpened keel-like extension of the ventrolateral border of the carapace, and in being more

distinctly acuminate posteriorly. The species is common in the type locality and in the Kirton Cementstone Series, Greetwell Quarry Lincoln. Young instars (already dimorphic) in all samples greatly outnumber adults.

Genus ***PNEUMATOCY THERE*** nov.

DERIVATION OF NAME. Greek, *πνεῦμα*, -*atos* "full of air or blown up", + *cythere*.

DIAGNOSIS. Progonocytherinae, strongly convex in dorsal view, a distinct lateral swelling extending slightly below ventral surface in side view, particularly posteroventrally. Marginal areas slightly compressed, oblique furrow commonly present below and behind anterior cardinal angle. Muscle scars a subvertical row of 4 oval adductor scars with single (occasionally 2 small scars), large anterodorsal antennal scar, and smaller rounded anteroventral mandibular scar. Radial pore canals straight, diverging slightly outwards away from the valve midline, few in number, and widely spaced. Inner margin and line of concrescence coincide. Normal pore canals large and rounded. Hinge antimerodont. Left valve larger than right which it overlaps evenly along ventral margin, and region of anterodorsal and posterodorsal slopes. Shell surface variously ornamented.

REMARKS. This genus, whose species are large, is not easily confused with any other known Bajocian ostracod. In shape, however, it is similar to *Progonocythere* Sylvester-Bradley from which it can be distinguished by its strongly convex carapace and in the possession of an antimerodont hinge. The normal pore canals in the type species are much larger than any exhibited by species of *Progonocythere*.

TYPE SPECIES. *Pneumatocythere bajociana* sp. nov.

Pneumatocythere bajociana sp. nov.

(Pl. 5, figs. 7-10; Pl. 6, figs. 1-10; Pl. 7, figs. 1-4; Text-figs. 6, 7)

DIAGNOSIS. A large species of *Pneumatocythere* characterized by weakly reticulate ornamentation of transverse and longitudinal ridges. This ornamentation may be absent owing to the state of preservation, in which case the rather large, circular normal pore canals are strongly visible.

HOLOTYPE. Io. 551, Yons Nab Beds, Cayton Bay, Yorkshire.

PARATYPES. Io. 552-557 and Io. 806-814 horizon and locality as above but including the marl bed beneath the Cave Oolite, South Cave, Yorkshire and the Kirton Cementstone Series, Lincoln.

DESCRIPTION. *Carapace* oval in outline with sexual dimorphism apparent, presumed males being the more elongate. Greatest length extending through midpoint, greatest height at the centre of the carapace in the female, slightly behind centre in the male. The carapace shows a marked degree of inflation, the greatest width being at or slightly behind the valve centre. The ventrolateral border of each valve is strongly convex, projecting slightly below the ventral surface, particularly midventrally. Marginal borders compressed. Anteriorly an oblique

furrow extends from the anterior cardinal angle towards the anteroventral margin. Shell surface ornamented by weakly developed longitudinal ridges, most strongly developed along the lateral border, and weak transverse ridges: the whole producing a weak reticulation. Depending upon preservation the ornament may be lacking completely, in which case the rather large, circular normal pore canals are distinctly visible, evenly spaced over the valve surface. *Left valve* larger than the right which it strongly overreaches along the dorsal margin and around the anterior margin. Posteriorly the right valve tends slightly to overreach the left. Ventrally the left valve slightly overlaps the right. Dorsal margin strongly convex in the left valve with indistinct cardinal angles. In the *right valve* the dorsal margin is not so strongly convex and as in the left valve the posterior cardinal angle is the most strongly developed. Anterior broadly rounded, posterior triangular with a strongly concave posterodorsal slope and a convex posteroventral slope. Ventral margin convex with an anteromedian incurvature. *Hinge* antimerodont with, in the left valve, terminal loculate sockets and a median denticulate bar, above which there is a distinct elongate accommodation groove. In the right valve the terminal elements of the hinge bear from 5 to 6 teeth, the median groove being locellate. The *muscle scars* consist of a subvertical row of 4 adductor scars situated anteriorly of the valve centre. The large, oval antennal scar is situated anterodorsally, although this may vary, the scar approaching anteromedian. The single antennal scar appears to be formed by the fusion of two smaller scars (pl. 7, fig. 2). The mandibular scar is rounded and situated anteroventally to the adductor scars. *Inner margin* and *line of concrescence* coincide. *Radial pore canals* rather thick, straight, diverging away from midline. Anteriorly there are 9 canals, 5 of which are placed below midline. Posteriorly there are only 4 canals of which 2 are situated almost at midline with one below and the fourth, not always clearly seen, dorsal to the other three. The selvage is distinct around the anterior and ventral margins.

Dimensions

HOLOTYPE. Io. 551 female carapace (Pl. 5, figs. 7-10), length 0.80 mm.; height 0.53 mm.; width 0.57 mm.

PARATYPES

Io. 552 male carapace (Pl. 6, figs. 1, 2, 5, 6), length 0.92 mm.; height 0.59 mm.; width 0.63 mm.

Io. 553 female carapace (Pl. 6, figs. 3, 4, 7, 9.), length 0.83 mm.; height 0.55 mm.; width 0.55 mm.

Io. 554 left valve female (Pl. 7, fig. 2; text-fig. 7), length 0.70 mm.; height 0.55 mm. (broken).

Io. 555 carapace (Pl. 7, fig. 1; text-fig. 6), length 0.60 mm.; height 0.39 mm.; width 0.39 mm.

Io. 556 left valve female (Pl. 6, figs. 8, 10; Pl. 7, fig. 3), length 0.72 mm.; height 0.48 mm.

Io. 557 right valve (Pl. 7, fig. 4), length 0.57 mm.; height 0.39 mm.

REMARKS. Ostracod I of Apostolescu (1959, pl. 4, figs. 67, 68) resembles this species very closely and is most probably congeneric. *Pneumatocythere bajociana* is common throughout the Lincolnshire Limestone, but, because of its poor preservation there an accurate description of the genus and species was dependent upon better material obtained from the Yons Nab Beds, which overlie the Millepore Oolite along the Yorkshire coast (see Bate, 1959) in the neighbourhood of Scarborough, and from the marl bed, underlying the Cave Oolite at South Cave.

Genus *ACANTHOCY THERE* Sylvester-Bradley emend

EMENDED DIAGNOSIS. Shell subrectangular, convex in dorsal view surface more or less spiny with large, round, prominent eye tubercles. Hinge antimerodont or lobodont.

TYPE SPECIES. *Cythere sphaerulata* Jones & Sherborn, 1888.

REMARKS. The original diagnosis of the genus indicated a single type of dentition only, namely, lobodont. However, the presence of a species, within the Bajocian sediments, almost identical with *A. sphaerulata* (Jones & Sherborn) except for the possession of an antimerodont hinge, necessitates a revised diagnosis of the genus, and the erection of a new subgenus, *Protoacanthocythere*.

Subgenus *PROTOACANTHOCY THERE* nov.

DIAGNOSIS. A subgenus of the genus *Acanthocythere* in which the hinge is antimerodont.

TYPE SPECIES. *Acanthocythere (Protoacanthocythere) faveolata* sp. nov.

Acanthocythere (Protoacanthocythere) faveolata sp. nov.

(Pl. 7, figs. 5-13, Pl. 8, figs. 1-5)

DERIVATION OF NAME. Latin, *favus*, a honeycomb.

DIAGNOSIS. A species of *Protoacanthocythere* with honeycomb ornamentation in which spines are developed at the transects of individual pits and along marginal borders.

HOLOTYPE. Io 558, Kirton Shale, Kirton Cement Quarry, Kirton Lindsey.

PARATYPES. Io. 559-65 and Io. 815-20, horizon and locality as above.

DESCRIPTION. *Carapace* subrectangular to subquadrate in side view; sexual dimorphism apparent, the presumed males being the more elongate. Anterior broadly rounded, slightly oblique dorsally with a short anterodorsal slope terminating at a large, shiny, eye tubercle, situated just to one side of the anterior cardinal angle. Posterior evenly rounded in the left valve with a short slightly concave posterodorsal slope in the right valve. Dorsal margin straight, ventral margin concave anteromedially, convex posteromedially. Lateral posteroventral margin swollen, overhanging the ventral margin. A distinct, thickened marginal keel is developed around the anterior and posterior margins extending along the ventral

margin almost up to midpoint. Left valve slightly larger than the right, overlapping the right along the ventral and posterior margins, slightly at the anterior cardinal angle but practically not at all around the anterior and along the dorsal margin. Greatest length extends throughout midpoint, greatest height in the anterior third. Ornamentation consists of a reticulate honeycomb pattern of ridges. The development of spines over the surface is variable in each specimen, generally however, a spine is produced where one ridge transects another. Spines are also produced along ridges as conical shaped structures thickest at their base and varying in length. Ventrally there is greater tendency for the development of spines along each ridge. Some of the specimens are excessively spinose, others are almost without spines at all. *Normal pore canals*, large circular and few in number. *Hinge* antimerodont, consisting of terminal dentate ridges (with approximately 5 anterior and 5 posterior teeth) and a long, narrow, finely locellate median groove in the right valve; left valve with terminal loculate sockets and a median bar which appears smooth in the specimens examined due to wear. The antimerodont nature of the hinge being deduced from the left valve. No accommodation groove. *Muscle scars* consist of a subvertical, slightly crescentic row of 4 adductor scars with an anterodorsal antennal scar and an anteroventral mandibular scar. Anteriorly a well developed flange extends as far as the anterior cardinal angle, and is often spinose (Pl. 8, fig. 1). Posteriorly the flange is reduced although it extends dorsally as far as the posterior cardinal angle. *Inner margin* and *line of concrescence* coincide. *Radial pore canals* few in number, straight and widely spaced around the anterior and posterior margins.

Dimensions

HOLOTYPE. Io. 558 female carapace (Pl. 7, figs. 5-7), length 0.60 mm; height 0.35 mm.; width 0.27 mm.

PARATYPES

Io. 559 male carapace (Pl. 7, figs. 10-13), length 0.65 mm.; height 0.37 mm.; width 0.36 mm.

Io. 560 left valve male (Pl. 8, fig. 2), length 0.64 mm.; height 0.39 mm.

Io. 561 right valve male (Pl. 7, figs. 8, 9), length 0.64 mm.; height 0.35 mm.

Io. 562 left valve female, length 0.61 mm.; height 0.37 mm.

Io. 563 right valve female (Pl. 8, fig. 1), length 0.61 mm.; height 0.37 mm.

Io. 564 right valve male (Pl. 8, figs. 3, 4), length 0.72 mm.; height 0.40 mm.

Io. 565 left valve male (Pl. 8, fig. 5), length 0.67 mm.; height 0.36 mm.

REMARKS. *Acanthocythere* (*Protoacanthocythere*) *faveolata* resembles *Acanthocythere sphaerulata* (Jones & Sherborn) in general shape, possession of prominent eye tubercles, similar radial pore canals and in the presence of dimorphism. The two species may, however, be distinguished by the possession of an antimerodont hinge and an obliquely rounded posterior in the former species. This ostracod occurs commonly throughout the Kirton Shale and the Kirton Cementstone Series of Lincolnshire.

Genus **FUHRBERGIELLA** Brand & Malz, 1962

Subgenus **PRAEFUHRBERGIELLA** Brand & Malz, 1962

Fuhrbergiella (Praefuhrbergiella) arens sp. nov.

(Pl. 8, figs. 6–15, Pl. 9, figs. 1–3)

DERIVATION OF NAME. Latin *arens*, dry or parched.

DIAGNOSIS. A species of the subgenus *Praefuhrbergiella* with distinctive ornamentation of irregular ridges giving the carapace a dried, shrivelled appearance. Particularly in the female dimorph the postero-ventrolateral border of the valves projects below the ventral surface. Hinge weakly entomodont.

HOLOTYPE. Io. 566, Kirton Shale, Kirton Cement Quarry, Kirton Lindsey.

PARATYPES. Io. 567–570 and Io. 821–22, horizon as above together with the Kirton Cementstone Series, Kirton Lindsey.

DESCRIPTION. *Carapace* subquadrate in outline, posteriorly flattened in dorsal view. Sexual dimorphism indicated by the more elongate dimorphs which are considered to be the males. In comparison with the more squat female dimorphs, the males are rare. Greatest length of carapace dorsal of midpoint in the female, extending through midpoint in the male. Greatest height in the anterior third. In dorsal view the sides of the carapace expand posteriorly in the female but are more uniformly convex in the male. As a result the greatest width is posterior in the female and median in the male. Dorsal margin straight with a slight dorsomedian convexity. Cardinal angles distinct. Ventral margin convex with a slight median incurvature. Anterior broadly and uniformly rounded, posterior triangular, more distinctly rounded in the male dimorph. Posterodorsal slope slightly concave, posteroventral slope convex. Anterior and posterior marginal areas flattened. Right valve in particular has a broad posterodorsal swelling which projects slightly above the dorsal margin. Ventrolateral border of both valves strongly convex, projecting below the ventral surface. In the male this swelling tends to be rather uniform along the length of the valve, whilst in the female it is more pronounced posteroventrally, giving the female carapace a triangular or deltoid appearance in dorsal view. Surface of carapace ornamented with an irregular pattern of thin platy ridges, ventrolaterally orientated parallel to the lateral border, elsewhere rather irregular but roughly anteroventral to posterodorsal, although minor ridges, horizontally directed, occur. The appearance afforded by the ridges is that of a shrivelled surface. An elongate eye swelling is situated at the anterior cardinal angle, below which is a rather deeply incised furrow opening at the dorsal margin and extending obliquely downwards and forwards for a short distance below the eye swelling. A deeply incised, crescent-shaped furrow, situated anteromedially on the carapace, marks the position of the adductor scars. Ventral surface flattened, ornamented by 4–5 longitudinal ridges on each valve, the outer two uniting close to the posterior. Left valve larger than right, overlapping it slightly along the ventral margin and around the anterior and posterior margins, and overreaching it dorsally. *Muscle scars* consist of a subvertical row of 4 small adductor scars with a rounded anterodorsal antennal scar and a small rounded anteroventral mandibular scar.

Hinge weakly entomodont, sufficiently developed in the anteromedian portion of the median element, particularly in the male dimorph, to be distinguished from an antimerodont hinge. Left valve with terminal loculate sockets and a median dentate bar, the latter in all cases too poorly preserved to confirm a more coarsely dentate anterior portion. No accommodation groove, although a narrow ledge is present above the median bar. In the right valve the hinge consists of terminal dentate ridges possessing 4-5 teeth, although generally there appears to be one tooth less anteriorly. Median groove loculate, expanded slightly in the anterior portion. *Inner margin* and *line of concrescence* coincide. *Radial pore canals* simple, straight and rather widely spaced; anteriorly there are 7-8 pore canals whilst posteriorly there are approximately 4 in number of which 2 are situated medially and are slightly curved. The selvage is prominent around the free margin. A prominent flange extends around the anterior margin but becomes less well developed along the ventral margin.

Dimensions

HOLOTYPE. Io. 566 female carapace (pl. 8, figs. 11, 12, 14, 15), length 0.53 mm.; height 0.32 mm.; width 0.32 mm.

PARATYPES.

Io. 567 right valve male (Pl. 8, figs. 8, 10, 13), length 0.61 mm.; height 0.33 mm.

Io. 568 right valve female (Pl. 8, fig. 7; Pl. 9, figs. 1, 3), length 0.47 mm.; height 0.27 mm.

Io. 569 left valve female (Pl. 8, fig. 6; Pl. 9, fig. 2), length 0.48 mm.; height 0.30 mm.

Io. 570 right valve female (Pl. 8, fig. 9), length 0.48 mm.; height 0.28 mm.

REMARKS. *Fuhrbergiella* (*Praefuhrbergiella*) *arens* is similar to *Fuhrbergiella* (*P.*) *sauzei* Brand & Malz, to which it is probably ancestral. However, the present species differs from the latter (and other species described by Brand & Malz, 1962) in the possession of ridges rather more widely but less regularly spaced, and in the greater tendency of the posteroventral border of the female carapace to overhang the ventral margin. This species is common but not abundant in the type locality and in the Kirton Cementstone Series of Lincoln.

Genus *AULACOCY THERE* nov.

DERIVATION OF NAME. Greek, *αὐλαξ*, *-akos*, a furrow, + *cythere*.

DIAGNOSIS. A genus of Progonocytherinae, rather subquadrate in outline with horse-shoe shaped swelling the opening of which is directed antroventrally. Left valve larger than right, projecting strongly above right valve in region of anterior cardinal angle. Eye swelling large, oval. Hinge antimerodont, without accommodation groove. Muscle scars a subvertical row of 4 adductor scars with rounded anterodorsal antennal scar and similarly shaped anteroventral mandibular scar. Radial pore canals few, straight and widely spaced.

TYPE SPECIES. *Aulacocythere punctata* sp. nov.

REMARKS. Two species of this genus have so far been found in the Middle Jurassic sediments of Lincolnshire, namely, *A. punctata* sp. nov. and *A. reticulata* sp. nov. Despite the variation in ornament as indicated by their specific names, both possess the horse-shoe shaped swelling, characteristic of the genus. Sexual dimorphism occurs in both species, the presumed males being more elongate in outline.

Aulacocythere punctata sp. nov.

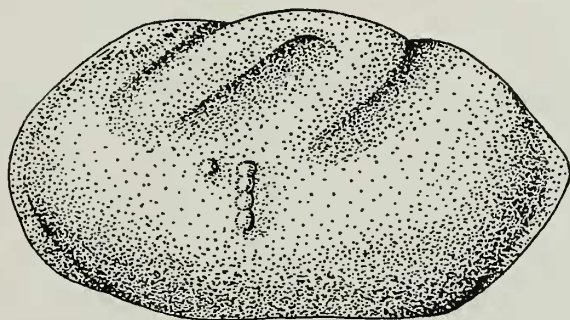
(Pl. 9, figs. 4-9, 11, 12, 14-15)

DERIVATION OF NAME. Latin, *punctum*, a small hole.

DIAGNOSIS. A species of *Aulacocythere*, with strongly punctate ornamentation.

HOLOTYPE. Io. 571, Kirton Shale, Kirton Cement Quarry, Kirton Lindsey.

PARATYPES. Io. 572-74 and Io. 823-28, horizon and locality as above.



14

FIG. 14. *Aulacocythere* gen. nov. Left valve illustrating the generic characters: shape, horse-shoe swelling, eye swelling and muscle scars.

DESCRIPTION. *Carapace* somewhat inflated, subrectangular in side view. Sexual dimorphism apparent, the presumed males being more elongate: in dorsal view the males are also less inflated and tend to be parallel-sided. Dorsal margin in both valves straight. Cardinal angles in the left valve swollen, not so distinct in the right valve. Anterior uniformly rounded, slightly oblique dorsally in the right valve. Posterior narrowly rounded in the left valve, tapering in the right, becoming somewhat triangular with a short, concave, posterodorsal slope and a convex posteroventral slope. Left valve larger than the right, overreaching it on all sides, particularly anterodorsally, and also slightly overlapping it along the ventral margin. Anterior and posterior marginal areas compressed, distinct from the convex part of the valve. Shell surface ornamented by closely set puncta which cover the entire lateral part of the valve. Ventrally the carapace is less noticeably punctate and is here ornamented with 3-4 longitudinal ridges in each valve. The characteristic horse-shoe shaped swelling which opens anteroventrally, is particularly well developed. In both valves, but especially in the left, a distinct swelling below the anterior cardinal angle is indicative of an eye swelling. The ventrolateral border of the

carapace is strongly convex and overhangs the ventral surface, particularly in the posteroventral region. *Hinge* antimerodont? : left valve with terminal loculate sockets and a median bar rather worn in the specimens examined—no accommodation groove. Right valve with terminal dentate ridges possessing 7 teeth. Median groove poorly preserved may be locellate. *Muscle scars* which often appear as upraised spots on the exterior, consist of 4 oval adductor scars with a single, oval, anterodorsal antennal scar and a single, rounded, anteroventral mandibular scar. Selvage prominent around the free margin, outside of which there is a narrow flange. *Inner margin* and *line of concrescence* coincide, *radial pore canals* straight and widely spaced : approximately 10 anteriorly and 3-4 posteriorly.

Dimensions

HOLOTYPE. Io. 571 male carapace (Pl. 9, figs. 8, 11, 14, 15) length 0.48 mm. ; height 0.27 mm. ; width 0.24 mm.

PARATYPES.

Io. 572 right valve male (Pl. 9, figs. 4, 7) length 0.44 mm. ; height 0.24 mm.

Io. 573 right valve female (Pl. 9, fig. 5) length 0.40 mm. ; height 0.24 mm.

Io. 574 left valve female (Pl. 9, figs. 6, 12) length 0.41 mm. ; height 0.24 mm.

REMARKS. Although the antimerodont hinge can be clearly seen in *A. reticulata* it is difficult to state definitely whether this is so in *A. punctata*. In some respects this species resembles *Oligocythereis woodwardi* Sylvester-Bradley (1948, pl. 122, figs. 7-12) in general outline, but differs in the possession of a horse-shoe shaped swelling and an antimerodont? hinge. A common species occurring both in the Kirton Shale and the Kirton Cementstone Series of Lincolnshire.

Aulacocythere reticulata sp. nov.

(Pl. 9, figs. 10, 13, 16-25 ; Pl. 10, fig. 1)

DERIVATION OF NAME. Latin, *reticulatus*, netlike.

DIAGNOSIS. A species of *Aulacocythere* with strong, reticulate ornamentation.

HOLOTYPE. Io. 575, Kirton Shale, Kirton Cement Quarry, Kirton Lindsey.

PARATYPES. Io. 576-79 and Io. 829-40, horizon and locality as above.

DESCRIPTION. *Carapace* subrectangular in outline ; sexual dimorphism apparent, presumed males being more elongate. Shell surface ornamented with a strong reticulate net work of 5 or 6 sided pits. The horse-shoe swelling prominent in the type species, is also prominent here. Eye swelling large, oval, situated just below the anterior cardinal angle. Valves convex, although males, as seen in dorsal view, tend to be rather parallel-sided. Ventrolateral border slightly swollen ; anterior broadly rounded ; posterior narrowly rounded, acuminate-triangular in the right valve. Dorsal margin straight, convex anteriorly and posteriorly in the left valve ; ventral margin slightly concave medially. Ventral surface of each valve ornamented with 3-4 longitudinal ridges. Anterior and posterior margins compressed, forming

a marginal border. Left valve larger than the right which it overreaches on all sides, particularly in the region of the anterior cardinal angle. Greatest length median, greatest height in the anterior third, greatest width in the posterior half. *Hinge* antimerodont; left valve with terminal loculate sockets and a coarsely denticulate median bar, no accommodation groove. In the right valve the hinge consists of terminal dentate ridges bearing 6 teeth and a locellate groove. Selvage prominent around the free margin, outside of which there is a distinct flange. *Radial pore canals* straight, few in number (exact number not observed) and widely spaced. *Muscle scars*, which are often seen on the exterior as upraised spots, as for the genus. *Inner margin* and *line of concrescence* coincide. Young instars possess a left valve which strongly projects above the right valve dorsally.

Dimensions

HOLOTYPE. Io. 575 female carapace (Pl. 9, figs. 10, 13, 20, 21), length 0.44 mm; height 0.29 mm; width 0.27 mm.

PARATYPES.

Io. 576 male carapace (Pl. 9, figs. 16-19), length 0.49 mm.; height 0.25 mm.; width 0.27 mm.

Io. 577 left valve male (Pl. 10, fig. 1), length 0.49 mm.; height 0.28 mm.

Io. 578 juv. carapace (Pl. 9, figs. 23, 24), length 0.36 mm.; height 0.20 mm.; width 0.18 mm.

Io. 579 right valve male (Pl. 9, figs. 22, 25), length 0.52 mm.; height 0.27 mm.

REMARKS. A species so far recorded only from the type locality in Lincolnshire where it occurs fairly frequently throughout the entire thickness of the Kirton Shale.

Genus *CAMPTOCYTHERE* Triebel, 1950

REMARKS. *Camptocythere* is placed in the Progonocytherinae on the evidence of the muscle scars and radial pore canals.

TYPE SPECIES. *Camptocythere praecox* Triebel, 1950.

Camptocythere lincolnensis sp. nov.

(Pl. 10, figs. 2-13)

DIAGNOSIS. A species of *Camptocythere* with distinct quadrate outline and ornament of rather large irregular pits.

HOLOTYPE. Io. 580, Kirton Cementstone Series, Greetwell Quarry, Lincoln.

PARATYPES. Io. 581-83, horizon and locality as above.

DESCRIPTION. *Carapace* quadrate, rather angular in outline with a broad, flattened area in the dorsomedian part of the carapace. Shell surface ornamented with large, irregularly shaped pits. Sexual dimorphism suggested by the presence

of a single left valve slightly more elongate than the other left valves examined, but the evidence is not strong. Greatest length of carapace along midline, greatest height in the anterior third. Greatest width situated in the posterior third, although in dorsal view the carapace is virtually parallel-sided with a slight compression medially. Anteriorly and posteriorly there is a narrow, compressed marginal border. *Left valve* slightly larger than the right which it overlaps along the ventral margin and overreaches around the anterior and posterior margins; dorsally the right valve overlaps the left. In outline the left valve tends to be subquadrate with a straight dorsal margin, the latter projecting dorsally at the anterior cardinal angle. Posterior cardinal angle broadly rounded. Anterior broadly and uniformly rounded. Posterior tapering, narrowly rounded. Ventral margin strongly convex, sweeping upwards posteriorly. *Right valve* quadrate in outline with a very slightly convex dorsal margin, sloping gently to the posterior. Cardinal angles more sharply angled than in the left valve. Anterodorsal slope short and slightly convex, posterodorsal slope short and slightly concave. Anterior margin rounded, posterior broadly triangular. Ventral margin broadly convex with a median incurvature. In both valves the ventrolateral border is swollen, overhanging the ventral surface. Left valve swollen in the region of the anterior cardinal angle and to a lesser degree along the dorsal margin. The right valve is equally swollen at the anterior and posterior angles, but to a lesser degree dorsomedially. The median depression in both valves is separated from the dorsal margin by the dorsal swelling. *Hinge* lopodont. In the right valve the terminal hinge elements are non-dentate, and connected by a long, straight, smooth median groove. In the left valve the terminal sockets are smooth, open to the interior of the valve ventrally. The smooth median element in the left valve is formed by the slightly downset dorsal edge of the valve. No accommodation groove. *Muscle scars* consist of a subvertical row of 4 rounded adductor scars with a rather oval anterodorsal antennal scar, no mandibular scar has been seen. *Radial pore canals* straight, widely spaced, approximately 8-10 anteriorly and 2-3 posteriorly. *Inner margin* and *line of concrescence* coincide. The selvage is prominent around the free margin in both valves.

Dimensions

HOLOTYPE. Io. 580 carapace (Pl. 10, figs. 2-5), length 0.48 mm.; height 0.31 mm.; width 0.28 mm.

PARATYPES.

Io. 581 left valve (Pl. 10, figs. 8, 9), length 0.47 mm.; height 0.32 mm.

Io. 582 right valve (Pl. 10, figs. 11, 12), length (broken) 0.44 mm.; height 0.29 mm.

Io. 583 right valve (Pl. 10, figs. 6, 7, 10, 13), length 0.44 mm.; height 0.29 mm.

REMARKS. *Camptocythere lincolnensis* differs from other species of the genus in that the right valve does not project so strongly above the left and the hinge does not slope so strongly to the posterior. This is a rather rare ostracod, so far only found in the Kirton Cementstone Series.

Subfamily **PLEUROCYTHERINAE** Mandelstam, 1960

REMARKS. This subfamily, introduced by Mandelstam (1960) was included by Howe (Moore, 1961: Q. 327) in the subfamily Protocytherinae Ljubimova (1955.) However it is considered to be a satisfactory group for those ostracods which have the following characters in common. Carapace elongate, often strongly ornamented. Hinge variable. Inner margin and line of concrescence coincide, the duplicature being of moderate width. Radial pore canals curved. Muscle scars consisting of a subvertical row of 4 adductor scars with a kidney-shaped anterodorsal antennal scar and an oval or rounded anteroventral mandibular scar (type A). At the moment only *Pleurocythere* Triebel (1951) is included in the subfamily.

Genus **PLEUROCYTHERE** Triebel, 1951

Pleurocythere kirtonensis sp. nov.

(Pl. 10, figs. 14-18, Pl. 11, figs. 1-5)

DIAGNOSIS. A species of *Pleurocythere* with three well developed longitudinal ridges and prominent anterior marginal ridge, the latter not connected to median longitudinal ridge. Carapace strongly reticulate.

HOLOTYPE. Io. 584, Kirton Shale, Kirton Cement Quarry, Kirton Lindsey.

PARATYPES. Io. 585-87 and Io. 841-46, horizon and locality as above.

DESCRIPTION. *Carapace* elongate, rounded anteriorly, acuminate-triangular posteriorly. Dorsal margin straight to slightly concave, in the right valve, with a slight inclination to the posterior, convex in the left. Apart from the dorsal keel of the left valve the ornamentation of the carapace is the same for both valves. The anterior marginal ridge is a continuation of the oblique anterodorsal ridge. Of the three longitudinal ridges, the two situated on the ventrolateral border are the most strongly developed. The oblique median ridge (uppermost of the three) is short in this species, to the rear of which is a short posterodorsal ridge, typical of the genus. This latter ridge is most strongly developed in the right valve. Shell surface rather coarsely reticulate. A slight swelling at the termination of the oblique anterodorsal ridge is suggestive of an eye swelling. Left valve larger than the right which it overlaps midventrally and overreaches dorsally. *Hinge* merodont, consisting in the left valve of terminal loculate sockets and a median bar, above which is a shallow accommodation groove. In the right valve the terminal elements bear 5 teeth both anteriorly and posteriorly. Median groove poorly preserved. It is therefore difficult to determine whether the hinge is antimerodont or hemimerodont. *Muscle scars* not seen. *Inner margin* and *line of concrescence* coincide, *radial pore canals* are long anteriorly although not clearly seen. Posteriorly the radial canals, which are 4 in number, curve slightly outwards away from midline. A well developed flange is present outside the selvage, being particularly well developed around the anterior margin, often poorly represented ventrally, especially in the left valve.

Dimensions

HOLOTYPE. Io. 584 female carapace (Pl. 10, figs. 14, 16, Pl. 11, figs. 4, 5), length 0.68 mm.; height 0.37 mm.; width 0.31 mm.

PARATYPES.

- Io. 585 left valve female (Pl. 10, figs. 15, 17), length 0.67 mm. ; height 0.35 mm.
 Io. 586 right valve male (Pl. 10, fig. 18 ; Pl. 11, figs. 2, 3), length 0.68 mm. ; height 0.33 mm.
 Io. 587 right valve male (Pl. 11, fig. 1), length 0.73 mm. ; height 0.36 mm.

REMARKS. *Pleurocythere kirtonensis* resembles *P. impar* Triebel (1951, pl. 45, figs. 8-12) from which it can be distinguished by the absence of a connecting ridge between the median ridge and the anterodorsal part of the marginal ridge. It is a common species within the Kirton Shale and also in the Kirton Cementstone Series of Kirton Lindsey.

Pleurocythere nodosa sp. nov.

(Pl. 11, figs. 6-21)

DERIVATION OF NAME. Latin, *nodosus*, knotted.

DIAGNOSIS. A species of *Pleurocythere* with two longitudinal ridges, poorly developed oblique anterior ridge and large eye swelling. Small, rounded nodes ornament the shell surface. Anterior and posterior margins dentate.

HOLOTYPE. Io. 588, Kirton Shale, Kirton Cement Quarry, Kirton Lindsey.

PARATYPES. Io. 589-92 and Io. 847-55, horizon and locality as above.

DESCRIPTION. *Carapace* elongate-quadrate, rounded anteriorly. Posterior acuminate-triangular. Both the anterior and posterior margins are dentate. Sexual dimorphism indicated by the presence of elongate specimens which are considered to be the males. Greatest length median, greatest height and width in the anterior third. Left valve larger than the right which it overlaps along the ventral margin. Dorsal keel in the left valve and a curved posterodorsal ridge in the right valve ; otherwise the ornamentation of both valves is the same. Only two longitudinal ridges occur in this species, a horizontal ventrolateral and an oblique median ridge, the latter giving off an anteriorly directed ridge from its posterior part, in the right valve. Shell surface smooth except for small nodes, irregularly scattered between the ridges. A distinct eye swelling is developed just below the anterior cardinal angle. Eye swelling connected in young instars to a thin, anterior ridge, poorly developed, if at all, in adults. Ventral surface with three faint ridges on each valve. *Hinge* antimerodont. Left valve with terminal loculate sockets and a finely denticulate median bar, no accommodation groove. Right valve with terminal dentate ridges (possessing approximately 7 teeth) and a long, narrow locellate median groove, although the latter is not clearly seen because of the state of preservation. *Inner margin* and *line of concrescence* coincide, radial pore canals long, but not clearly seen. *Muscle scars* not seen. A flange extends around the anterior and posterior margins outside the selvage, but ventrally it is only poorly developed.

Dimensions

HOLOTYPE. Io. 588 female carapace (Pl. 11, figs. 6, 7, 9, 10), length 0.47 mm. ; height 0.25 mm. ; width 0.23 mm.

PARATYPES.

Io. 589 male carapace (Pl. 11, figs. 13-16), length 0.49 mm.; height 0.24 mm.; width 0.20 mm.

Io. 590 right valve male (Pl. 11, figs. 12, 17), length 0.49 mm.; height 0.23 mm.

Io. 591 left valve female (Pl. 11, figs. 8, 11), length 0.47 mm.; height 0.25 mm.

Io. 592 juv. carapace (Pl. 11, figs. 18-21), length 0.36 mm.; height 0.17 mm.; width 0.16 mm.

REMARKS. This species differs from *P. kirtonensis* in the possession of a surface ornament of small nodes, large eye swelling and the attachment of the posterodorsal ridge to the posterior part of the median ridge. Although found with *P. kirtonensis*, in the Kirton Shale, this smaller species is not nearly as common.

Family CYTHERIDEIDAE Sars, 1925

Subfamily CYTHERIDEINAE Sars, 1925

Genus *DOLOCYTHERE* Mertens, 1956

1959. *Lophodentina*, Apostolescu, p. 813.

DIAGNOSIS. A thick-shelled subrectangular genus of Cytherideinae possessing 8-12, straight, anterior and about 6 posterior radial pore canals. Hinge lophodont. Shell surface variously ornamented. Left valve larger than right.

TYPE SPECIES. *Dolocytthere rara* Mertens, 1956.

REMARKS. On the general characters of shape, thickness of the carapace, simple radial pore canals associated with a moderately developed duplicature in which the inner margin and line of concrescence coincide, *Dolocytthere* Mertens 1956 has been placed in the family Cytherideidae Sars 1925, subfamily Cytherideinae Sars 1925. The type of muscle scar arrangement with a bill-hook shaped antennal scar and a mandibular support spot, is considered here to be typical of the family.

Dolocytthere maculosa sp. nov.

(Pl. 12, figs. 1-11; Text-figs. 8, 9)

DERIVATION OF NAME. Latin, *maculosus*, spotted.

DIAGNOSIS. A species of *Dolocytthere*, slightly constricted in mid-dorsal/mid-ventral region and ornamented with large, circular pits irregularly scattered over carapace.

HOLOTYPE. Io. 609, marl below the Cave Oolite, Eastfield Quarry, South Cave, Yorkshire.

PARATYPES. Io. 610-13 and Io. 856-75, horizon and locality as above.

DESCRIPTION. *Carapace* subrectangular in side view, dorsal and ventral margins slightly concave medially, anterior uniformly rounded, posterior obliquely rounded. Greatest width of carapace posteroventral, greatest length passing through midpoint,

greatest height in the anterior third. Left valve slightly larger than the right which it overreaches around the anterior margin, slightly around the posterior margin, and with some overlap at about the centre of the ventral margin. Surface of carapace covered with large, circular, rather shallow pits, within each of which is a large normal pore canal. Anteriorly and posteriorly the marginal border is compressed, partially obscured posteroventrally by the convexity of the carapace. Cardinal angles distinct, slightly swollen in dorsal view. *Hinge* lophodont. Left valve with the smooth median element formed by the dorsal edge of the valve which is here slightly downset; the terminal sockets, produced by the upward projection of the dorsal margin remain open ventrally. In the right valve the smooth terminal elements, extensions of the selvage, are bent at the cardinal angles, whilst medially there is a long, straight, narrow groove above which there is a long narrow bar, the latter separated from the dorsal edge of the valve by a faint groove. *Inner margin* and *line of concrescence* coincide. *Radial pore canals* straight and widely spaced, 9-10 anteriorly, 3 posteriorly. The *muscle scars* consist of a subvertical row of 4 adductor scars, the two central scars being the more elongate. The antennal scar, situated anterodorsally, is composed of two distinct scars, a large, bill-hook shaped scar and a smaller scar situated above the lower limb of the bill-hook. The opening of the antennal scar is directed obliquely upwards towards the anterior cardinal angle. In some specimens (Pl. 12, fig. 7) an oval "mandibular stutzfleck" (mandibular support spot) can be seen situated in front of the dorsal adductor scar. The large, oval mandibular scar is situated anteroventrally to the adductor scars. In both valves the selvage is prominent around the free margin, external to which is a well developed flange, the latter extending around the anterior, posterior and ventral margins of the right valve but largely confined to the anterior margin of the left valve.

Dimensions

HOLOTYPE. Io. 609 left valve (Pl. 12, figs. 1, 2, 6), length 0.60 mm.; height 0.35 mm.

PARATYPES.

Io. 610 carapace (Pl. 12, figs. 8, 9), length 0.64 mm.; height 0.35 mm.; width 0.33 mm.

Io. 611 right valve (Pl. 12, figs. 3-5), length 0.61 mm.; height 0.37 mm.

Io. 612 left valve (Pl. 12, figs. 10, 11, Text-fig. 8), length 0.62 mm.; height 0.36 mm.

Io. 613 right valve (Pl. 12, fig. 7, Text-fig. 9), length 0.60 mm.; height 0.35 mm.

REMARKS. *Dolocythere maculosa* can be distinguished from *D. rara* Mertens (1956, pl. 10, figs. 33-37) and *Lophodentina lacunosa* Apostolescu (1959, pl. 3, figs. 56, 57) by its lack of a reticulate ornament. The specimens of *D. maculosa* described here were obtained from the marl below the Cave Oolite of South Yorkshire, where they are extremely common. Although common also in the Kirton Shale and Kirton Cementstone Series of Lincolnshire the specimens are too poorly preserved for accurate description.

Family **SCHULERIDEIDAE** Mandelstam 1959Subfamily **SCHULERIDEINAE** Mandelstam 1959

REMARKS. Four genera (*Schuleridea* Swartz & Swain, 1946, *Asciocythere* Swain, 1952, *Galliaecytheridea* Oertli, 1957, and *Nodophthalmocythere* Malz, 1958) placed in the family Cytherideidae Sars, 1925, subfamily Cytherideinae Sars, 1925, in the *Invertebrate Paleontology Treatise, Part Q*, are closely related in shape, radial pore canals and arrangement of the muscle scars (Type "C"). A fifth genus, *Praeschuleridea* gen. nov., is also closely related in these three characters. All these genera differ from the others placed within the Cytherideinae in the arrangement of the muscle scars, to some extent in outline and in the tendency for the radial pore canals to be arranged fan-like around the anterior margin. Indeed, there appears to be little reason to retain these genera within the family. Hence the subfamily Schulerideinae Mandelstam (1959) is retained and the Schulerideidae Mandelstam given family status.

The genera placed in the subfamily *Cuneocytherinae* Mandelstam, 1960 (Moore, 1961) also belong in this family.

Genus **PRAESCHULERIDEA** nov.

DERIVATION OF NAME. Latin, *prae* before, + *Schuleridea* (an ostracod genus erected by Swartz & Swain, 1946).

DIAGNOSIS. Carapace ovoid in outline, ornamented or smooth. Hinge paleohemimerodont. Greatest length of carapace along midlength. Radial pore canals arranged in a fan, curving slightly outwards away from a line drawn through midpoint, 12-16 anteriorly, 4-6 posteriorly. Muscle scars consist of a crescentic row of 4 oval adductor scars with centrally situated anterior antennal scar, often kidney-shaped with small secondary scar in front but sometimes rounded: mandibular scar, when seen, in front of and below adductor scars.

TYPE SPECIES. *Cytheridea subtrigona* Jones & Sherborn, 1888.

REMARKS. *Praeschuleridea* differs from *Schuleridea* Swartz & Swain in having a more uniformly ovoid outline in lateral view, the greatest length being through midpoint and not ventral of midpoint as is often the case in the latter genus. Radial pore canals are identical in both genera except in number—there are about 30 anterior and 10 posterior in *Schuleridea* and only 12-16 anterior and 4-6 posterior in *Praeschuleridea*. Finally, whereas the hinge in *Schuleridea* is paleomerodont, with the median element of the right valve projecting beyond the commissure in dorsal view, the hinge in *Praeschuleridea* is paleohemimerodont, with the median element of the left valve projecting beyond the commissure as seen in dorsal view.

Praeschuleridea subtrigona (Jones & Sherborn)

(Pl. 12, figs. 12-16; Pl. 13, figs. 1-9; Text-fig. 15)

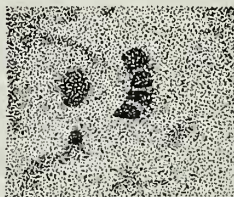
1888 *Cytheridea subtrigona* Jones & Sherborn, p. 265, pl. 2, fig. 9a-c.

DIAGNOSIS. A species of *Praeschuleridea* with subtrigonal carapace when viewed

laterally. Right valve more elongate than left, more acuminate posteriorly. Hinge paleohemimerodont. Muscle scars and radial pore canals as for genus. Carapace smooth with very fine puncta.

LECTOTYPE (chosen here) I. 1838, a single right valve, Blue Fuller's Earth Clay, Midford, Bath.

DESCRIPTION. *Carapace* oval-subtriangular in side view, strongly convex with greatest width just behind valve centre. Sexual dimorphism strongly pronounced, the presumed males being the more elongate. Surface of valves finely punctate but may appear smooth and devoid of puncta if poorly preserved. A narrow, anterior marginal border on each valve. Left valve larger than the right which it overreaches on all sides, but more strongly along the dorsal and ventral margins, and which it strongly overlaps midventrally. Greatest length for both valves lies along midlength. Greatest height in the left valve at valve centre, but in the right valve in front of centre. As the right valve is more elongate than the left, and as the latter is subtrigonal, the dorsal margin of the left valve is more broadly convex than



15

FIG. 15. Muscle scars, *Praeschuleridea subtrigona* (Jones & Sherborn). Io. 594. $\times 200$

that of the right valve, and the cardinal angles are more strongly distinct in the latter. Anterior broadly rounded in both valves, posterior acuminate, more so in the right than in the left. The ventrolateral border in both valves slightly overhangs the ventral surface medially. A small swelling with an oblique furrow below is situated just beneath the anterior cardinal angle in the right valve—this feature, which may represent an eye swelling, is not seen in the left valve. *Hinge* paleohemimerodont. Left valve with terminal loculate sockets united across an upraised median bar by a long, narrow, smooth groove: above the median element a broad accommodation groove is developed. In the right valve the terminal dentate ridges bear 5 teeth anteriorly and 6–7 teeth posteriorly: a long, slender, smooth median bar fits into the groove of the left valve, but is itself situated in a depressed, groove-like depression and does not project beyond the line of the commissure when viewed dorsally. *Inner margin* and *line of concrescence* coincide to form a fairly broad duplicature. *Radial pore canals* splayed into a fan, approximately 12–16 anteriorly (11 seen in a juvenile specimen) and 4–6 posteriorly. *Muscle scars* consist of a crescentic row of 4 oval adductor scars with a single, rounded, anteromedian antennal scar. The mandibular scar is situated anteroventrally relative to the adductor scars.

Dimensions

Io. 593 left valve female (Pl. 13, fig. 6), length 0.51 mm. ; height 0.35 mm.

Io. 594 right valve female (Pl. 13, fig. 4 ; Text-fig. 15), length 0.47 mm. ; height 0.28 mm.

Io. 595 left valve female (Pl. 12, fig. 16), length 0.56 mm. ; height 0.35 mm.

Io. 596 male carapace (Pl. 13, figs. 1-3), length 0.53 mm. ; height 0.35 mm. ; width 0.27 mm.

Io. 597 female carapace (Pl. 12, figs. 12-15), length 0.51 mm. ; height 0.35 mm. ; width 0.27 mm.

Io. 598 right valve male (Pl. 13, figs. 7, 9), length 0.51 mm. ; height 0.29 mm.

Io. 599 left valve female (Pl. 13, figs. 5, 8), length 0.53 mm. ; height 0.36 mm.

REMARKS. Apart from the recorded occurrence of this species by Jones & Sherborn (1888), *P. subtrigona* is abundant in the middle Bajocian, Kirton Shale, Kirton Lindsey, and throughout the Lower Lincolnshire Limestone of Lincolnshire.

Family PROTOCYTHERIDAE Ljubimova 1955

REMARKS. The subfamily Protocytherinae Ljubimova, 1955, is placed as a subfamily of the Progonocytheridae Sylvester-Bradley, 1948, in the *Treatise on Invertebrate Paleontology* (Moore, 1961 : Q327). As mentioned previously (p. 191) the subfamily has been removed from the Progonocytheridae on the grounds that it did not belong there and resulted in the establishment of a strictly artificial family. The subfamily Protocytherinae is here raised to the level of a family, an important feature of which is the U- or V-shaped antennal muscle scar.

Subfamily KIRTONELLINAE nov.

DIAGNOSIS. Subquadrate, elongate to piriform with ventrolateral border often tending to overlap ventral margin. Hinge variable with or without accommodation groove. Duplicature of medium development with inner margin and line of concrescence coinciding. Radial pore canals straight, few and widely spaced. Adductor muscle scars consist of a subvertical row of 4 scars with anterodorsal U- or V-shaped antennal scar and anteroventral, rounded mandibular scar. Left valve larger than right. Shell surface smooth or ornamented.

REMARKS. This subfamily is differentiated from the Protocytherinae by the possession of straight radial pore canals, simple in character and few in number.

Genus *KIRTONELLA* nov.

DERIVATION OF NAME. After type locality.

DIAGNOSIS. A genus of the Kirtonellinae, dimorphic, subtriangular to subquadrate in outline with ventrolateral border of carapace tending to project ventrally as an

overfold. Hinge antimerodont. An eye swelling may be present just below anterior cardinal angle.

TYPE SPECIES. *Kirtonella plicata* sp. nov.

REMARKS. Although there is some resemblance between the female dimorphs of the type species of this genus and *Procytheridea* Peterson, the former can be distinguished by the type of overfold of the ventrolateral border and the presence of a U-shaped antennal muscle scar. There is no resemblance between the more elongate, male dimorphs of the respective type species. The dorsal margin, which is rather steeply angled in *Procytheridea* (the posterior cardinal angle being broad and indistinct), is less steeply inclined in *Kirtonella*, where the posterior cardinal angle is prominent.

***Kirtonella plicata* sp. nov.**

(Pl. 13, figs. 10-19; Pl. 14, figs. 1-6, 11, 12; Text-fig. 12)

DERIVATION OF NAME. Latin, *plicatus*, folded.

DIAGNOSIS. A species of *Kirtonella* with strong parallel folds extending along ventrolateral margin. Remainder of carapace ornamented with weak transverse wrinkles and pits.

HOLOTYPE. Io. 600, Kirton Shale, Kirton Cement Quarry, Kirton Lindsey.

PARATYPES. Io. 601-08 and Io. 879-81, horizon and locality as above.

DESCRIPTION. *Carapace* subquadrate to subtriangular in outline. Sexual dimorphism strongly apparent, the presumed males being the more elongate, the females shorter and subtriangular. In the latter, the dorsal margin is rather more strongly arched than in the male, where the dorsal margin is straight, being only slightly arched posteriorly. The downward slope of the dorsal margin and the upward slope of the ventral margin are responsible for the characteristic outline of the female dimorph. In the male the posterior taper is limited to the posterior third, dorsal and ventral margins being roughly parallel elsewhere. Anterior in both sexes broadly rounded, posterior triangular. Ventral margin slightly convex, sloping upwards posteriorly in the female. In both sexes the ventral incurvature of the carapace is situated just anterior of the valve middle. Left valve larger than the right, which it overlaps slightly along the ventral margin, elsewhere the left valve overreaches the right. A shallow groove extends around the anterior margin producing a raised outer rim. In side view a ventrolateral overfold of the valve, which tends to be more strongly developed posterolaterally, is ornamented by 3 longitudinal ridges, with occasionally 2 further rather faint ridges dorsal to these. Ventral surface of each valve ornamented by 3 or 4 longitudinal ridges. Shell surface ornamented laterally by strong circular pits, which tend to become irregular in shape in some specimens, often increasing in size medially where weak transverse ridges are developed. A shallow sulcus is situated just behind the position of the adductor muscle scars. Greatest length of carapace extends through midpoint whilst the greatest height is at the anterior cardinal angle. Greatest width just behind and above midpoint, particularly so in the case of the male dimorph which develops a distinct posterodorsal bulge. A slight swelling, particularly noticeable

in the left valve, may be seen below the anterior cardinal angle and probably represents an eye swelling. Hinge antimerodont, with, in the left valve, terminal loculate sockets and a coarsely dentate median bar, above which there is a narrow accommodation groove: in the right valve the hinge consists of 6 anterior and 7 posterior teeth separated by a loculate median groove. The *muscle scars* consist of a subvertical row of 4 rounded adductor scars with a U-shaped anterodorsal antennal scar and a circular anteroventral mandibular scar. *Line of concrescence* and *inner margin* coincide, producing a broad duplicature. *Radial pore canals* long, straight and widely spaced around the anterior margin, where there may be approximately 11 in number; posteriorly there are 4 radial canals. Selvage prominent, outside of which a flange is developed around the anterior margin and along the anterior two-thirds of the ventral margin.

Dimensions

HOLOTYPE. Io. 600 female carapace (Pl. 13, figs. 10-13), length 0.51 mm.; height 0.31 mm.; width 0.27 mm.

PARATYPES.

Io. 601 right valve male (Pl. 14, fig. 12), length 0.64 mm.; height 0.32 mm.

Io. 602 left valve male (Pl. 13, fig. 19; Pl. 14, figs. 3, 11), length 0.64 mm.; height 0.33 mm.

Io. 603 right valve male (Pl. 13, fig. 16), length 0.71 mm.; height 0.36 mm.

Io. 604 male carapace (Pl. 14, figs. 1, 2), length 0.67 mm.; height 0.35 mm.; width 0.30 mm.

Io. 605 left valve female (Pl. 13, figs. 17, 18; Pl. 14, fig. 5), length 0.43 mm.; height 0.25 mm.

Io. 606 right valve female (Pl. 14, figs. 4, 6), length 0.52 mm.; height 0.30 mm.

Io. 607 left valve female (Pl. 13, fig. 15), length 0.56 mm.; height 0.35 mm.

Io. 608 left valve female (Pl. 13, fig. 14; Text-fig. 12), length 0.56 mm.; height 0.33 mm.

REMARKS. In addition to the type locality *K. plicata* is also present in the marly bed (*A. crossi* Bed ?) at the top of the Kirton Cementstone Series, Greetwell Quarry, Lincoln.

Genus **SYSTEMOCY THERE** nov.

DERIVATION OF NAME. Greek, *σύστημα*, tapering to a point, + *cythere*.

DIAGNOSIS. Kirtonellinae, elongate to oval-subquadrate, tapering strongly to posterior, particularly in male dimorph. Right valve strongly overlapped by left in region of cardinal angles. Hinge antimerodont.

REMARKS. *Systemocythere* differs from *Kirtonella* gen. nov., in possessing a much more strongly tapered carapace and in the type of valvular overlap.

TYPE SPECIES. *Systemocythere exilofasciata* sp. nov.

Systemocythere exilofasciata sp. nov.

(Pl. 14, figs. 7-10, 13-17; Pl. 15, figs. 1-4)

DERIVATION OF NAME. Latin, *exilis*, poor; *fasciatus*, banded.

DIAGNOSIS. A species of *Systemocythere* with ornamentation of longitudinal ridges weakly developed in posterolateral region of carapace; elsewhere shell surface tends to be smooth.

HOLOTYPE. Io. 614, Kirton Cementstone Series, Kirton Cement Quarry, Kirton Lindsey.

PARATYPES. Io. 615-19, Io. 628, Io. 876-78, horizon and locality as above and from Cave Oolite and marl beneath, Eastfield Quarry, South Cave.

DESCRIPTION. Carapace strongly dimorphic, the female rather subquadrate with a short, tapered posterior; the male much more elongate, the posterior being drawn out and acuminate. Greatest length in both sexes extends below midpoint, greatest height in the anterior third, closer to midpoint in the male. Greatest width in the posterior third. Dorsal margin straight, sloping to the posterior at about 45 degrees. Anterior cardinal angle well rounded, almost "umbonate"; posterior cardinal angle distinct, particularly in the left valve. Anterodorsal slope slightly convex, much longer in the male. Posterodorsal slope slightly concave. Ventral margin convex, incurved anteromedially. Anterior margin obliquely rounded, posterior narrowly rounded, acuminate in the male, broadly triangular in the female. The posteroventral part of the carapace in both dimorphs is noticeably swollen with the lateral border slightly overhanging the ventral surface. *Normal pore canals* round and widely scattered over the shell surface. Ornamentation weak, with longitudinal ridges in the posterolateral region, the ridges following the ventral outline of the carapace. Secondary, weak, obliquely transverse ridges may be present in the posterior part of the carapace, but their presence, as in the case of the longitudinal ridges, is dependent on the state of preservation of the specimen. The ventral surface of the carapace is strongly ornamented by 4 longitudinal ridges on each valve. Left valve larger than the right which it strongly overlaps along the ventral margin (the degree of overlap increasing towards the posterior), and which it also strongly overlaps in the region of the cardinal angles; at the extreme anterior the valves meet without overlap whilst posteriorly the left valve overreaches the right. Along the dorsal margin the valves are withdrawn, almost exposing the median part of the hinge. *Hinge* strongly antimerodont. Left valve with loculate terminal sockets and a coarsely dentate median bar, above which is an elongate accommodation groove. Right valve with terminal dentate ridges bearing from 5-6 teeth and a coarsely loculate median groove. *Muscle scars* consist of a subvertical row of 4 adductor scars, of which the middle two are laterally elongate whilst the dorsal adductor scar is often elongate dorso-ventrally. The ventral adductor scar is oval, but in a single specimen it was seen to be divided into two small scars. The antennal scar is situated anterodorsally and is broadly U-shaped, formed by the fusion of 2 or more scars. The antero-

ventral, oval mandibular scar is not often seen. *Inner margin* and *line of concrescence* coincide. *Radial pore canals* long, straight and widely spaced, approximately 10-11 anteriorly and about 4 posteriorly.

Dimensions

HOLOTYPE. Io. 614 female carapace (Pl. 14, figs. 7-10), length 0.57 mm. ; height 0.33 mm. ; width 0.35 mm.

PARATYPES.

Io. 615 male carapace (Pl. 14, figs. 14, 15), length 0.63 mm. ; height 0.33 mm. ; width 0.36 mm.

Io. 616 right valve male (Pl. 14, fig. 17), length 0.61 mm. ; height 0.32 mm.

Io. 617 female carapace, length 0.60 mm. ; height 0.37 mm. ; width 0.37 mm.

Io. 618 left valve male (Pl. 14, figs. 13, 16 ; Pl. 15, fig. 3), length 0.71 mm. ; height 0.41 mm.

Io. 619 right valve male (Pl. 15, figs. 1, 2, 4), length 0.67 mm. ; height 0.37 mm.

REMARKS. The ratio of males to females in this species is an interesting one. In the type horizon, no male dimorphs have been found, whilst within the Cave Oolite, the males are equally, if not more so, as common as the females.

Genus *EKTYPHOCY THERE* nov.

DERIVATION OF NAME. Greek, *ἐκτυφῶν*, to puff up, + *cythere*.

DIAGNOSIS. Kirtonellinae, subtriangular to subrectangular, convex in dorsal view. Lateral border extended below ventral margin. Anterior and posterior marginal borders compressed. Slight swelling below anterior cardinal angle suggestive of eye swelling. Hinge antimerodont with broad, shelf-like accommodation groove in left valve. Left valve larger than right.

TYPE SPECIES. *Procytheridea triangula* Brand, 1961.

REMARKS. Externally *Ektyphocythere* resembles *Neocythere* Mertens, 1956, but differs principally in the possession of an antimerodont hinge. *Procytheridea* Peterson, 1954, is also similar, from which *Ektyphocythere* can be distinguished by the extension of the ventrolateral border below the ventral surface, possession of a U-shaped anterodorsal antennal muscle scar, and the development of a much more strongly convex carapace (in dorsal view).

Several species of *Procytheridea* recorded from the Lias (Europe) by Apostolescu (1959), Klingler & Neuweiler (1959), and Martin (1960), from the Bajocian (Europe) by Brand & Malz (1961) and from the Bathonian (Europe) by Oertli (1960) resemble *Ektyphocythere* more closely than they do *Procytheridea*. In all cases a distinctive ornament of ridges arranged in a triangular pattern is present. These species are listed below :—

Procytheridea luxuriosa Apostolescu
P. vitiosa Apostolescu
P. betzi Klingler & Neuweiler
P. triebeli Klingler & Neuweiler
P. laqueata Klingler & Neuweiler
P. spinaecostata Klingler & Neuweiler
 ? *P. arcuatocostata* Martin
P. parva Oertli
Procytherida triangula Brand

Variations in the ornament serve to distinguish the above species from *E. triangula*. The ostracod *Neocythere* ? *n.sp.* Oertli (1958, pl. 5, figs. 125-128) from the Aptian-Albian of southern France, closely resembles the large adults of *E. triangula* and is possibly congeneric. If a closer relationship between *Ektyphocythere* and *Neocythere* can be shown it may be preferable to consider the former as a subgenus of the latter.

Dr. G. A. Cooper of the Smithsonian Institution, Washington, U.S.A., kindly sent me specimens of *Procytheridea exempla* Peterson (locality Js-XV j, see Peterson, 1954: 156) and *P. crassa* Peterson (locality Js-XVIII c) to examine. In both cases the ostracods came from the same level as the holotype. This examination has shown that many of the European species placed in *Procytheridea* are not congeneric with the type species, *P. exempla*. Some almost certainly belong to *Ektyphocythere*. In addition, *P. crassa* is definitely not congeneric with *P. exempla* and should be removed from the genus. This is true also of the European species placed in *Procytheridea* on their resemblance to *P. crassa*.

***Ektyphocythere triangula* (Brand)**

(Pl. 15, figs. 5-18 ; Text-fig. 13)

1961. *Procytheridea triangula* Brand, p. 161, pl. 1, figs. 11-14.

EMENDED DIAGNOSIS. A species of *Ektyphocythere* with prominent triangular ornament of coarse ridges breaking down medially to produce reticulation. Ventro-lateral border extended below ventral surface, alaeform in large adults.

DESCRIPTION. *Carapace* subtriangular to subquadrate in outline with the ventro-lateral border extended below the ventral surface. Carapace strongly convex as seen in dorsal view. Greatest length extends through midpoint, greatest height slightly anterior of middle, greatest width in the posterior third in adult instars but tends to be more to the centre of the carapace in pre-adult instars. Shell surface ornamented by 3-4 coarse ridges situated obliquely in the anterodorsal and anteroventral parts of the carapace and continued ventrolaterally as longitudinal ridges. At the centre of this triangular arrangement the ridges tend to break up into a coarse reticulation. A slight swelling just below the anterior cardinal angle probably represents an eye swelling. The *normal pore canals*, when visible, rather large and circular, evenly spaced over the carapace. Ventrally each valve possesses

3 longitudinal ridges. Valve margins compressed with a thickened marginal rim. *Left valve* larger than the right which it overlaps midventrally and overreaches terminally. Dorsally the right valve overreaches the left. The dorsal margin in the left valve almost uniformly convex in pre-adult instars becoming rather more undulating with a median concavity in the larger adults. In the *right valve* a dorso-median bulge of the carapace projects above the dorsal margin, the latter tending to be straight or slightly convex. Anterior rounded, posterior triangular, the posterodorsal slope of the right valve being slightly more concave than in the left. Ventral margin convex with the valvular incurvature median or slightly in front of middle. *Hinge* antimerodont with terminal dentate ridges (with approximately 5 teeth) and a loculate median groove in the right valve. Left valve with the corresponding terminal loculate sockets and a dentate median bar above which is an elongate accommodation groove. *Inner margin* and *line of concrescence* coincide, the duplicature being quite broad. *Radial pore canals* straight and few in number, widely spaced and numbering 8–10 anteriorly and approximately 3 posteriorly. The selvage is prominent around the free margin, outside of which a flange is developed around the anterior and posterior margins. *Muscle scars* consist of a subvertical row of 4 oval adductor scars with a single U-shaped anterodorsal antennal scar and an oval anteroventral mandibular scar.

Dimensions

Io. 622 carapace (Pl. 15, figs. 8, 9), length 0.65 mm.; height 0.37 mm.; width 0.39 mm.

Io. 623 right valve (Pl. 15, fig. 5), length 0.64 mm.; height 0.35 mm.

Io. 624 left valve, length 0.73 mm.; height 0.45 mm.

Io. 625 right valve (Pl. 15, figs. 11, 14), length 0.51 mm.; height 0.31 mm.

Io. 626 left valve (Pl. 15, figs. 10, 13), length 0.52 mm.; height 0.35 mm.

Io. 627 carapace (Pl. 15, figs. 7, 12, 15, 17), length 0.52 mm.; height 0.33 mm.; width 0.33 mm.

Io. 692 right valve (Pl. 15, fig. 18), length 0.44 mm.; height 0.25 mm.

Io. 695 left valve (Pl. 15, fig. 16; Text-fig. 13), length 0.50 mm.; height 0.30 mm.

REMARKS. The specimens described here from the Kirton Shale, Kirton Lindsey, are certainly conspecific with *Procytheridea triangula* Brand, being identical with the specimens described by Brand (1961: 162, pl. 1, figs. 11–14) at the size range indicated, namely, length 0.47–0.51 mm. However, Brand does not mention larger adult instars which here differ quite considerably morphologically and attain a length of 0.73 mm. The most striking difference in these larger specimens is the increase in the ventrolateral extension of the valve. In addition the anterior ornamentation may become greatly reduced and the muscle scars show up as raised spots on the valve surface. The adult specimens of *E. triangula* bear little resemblance to the genus *Procytheridea* and compared with the smaller instars are relatively uncommon. Because of this latter factor it may be possible that those species mentioned previously which bear a resemblance to *E. triangula* might well possess larger instars as yet undescribed.

Family **LOXOCONCHIDAE** Sars, 1925Genus **CYTHEROMORPHA** Hirschmann, 1909***Cytheromorpha* (?) *greetwellensis* sp. nov.**

(Pl. 15, figs. 19-21)

DIAGNOSIS. *Cytheromorpha*?, small, elongate, carapace constricted medially by broad midventral depression. Surface finely pitted, producing an almost reticulate appearance.

HOLOTYPE. Io. 620, Kirton Cementstone Series, Greetwell Quarry, Lincoln.

PARATYPE. Io. 621, Kirton Shale, Kirton Cement Quarry, Kirton Lindsey.

DESCRIPTION. *Carapace* subrectangular in outline, tapering to the posterior. Greatest length extending through midpoint, greatest height at the anterior cardinal angle, greatest width situated in the posterior third. In dorsal view the ostracod is slender and almost parallel-sided with a slight median constriction. Dorsal margin straight, sloping slightly to the posterior. Cardinal angles distinct, rather broad. Ventral margin flattened medially, tending to be slightly concave, but convex anteroventrally and posteroventrally. Anterior high and uniformly rounded, posterior triangular with a short and straight, steeply angled posterodorsal slope and a short, slightly convex posteroventral slope. A slight swelling extends along the ventrolateral part of the carapace. Shell surface uniformly ornamented with small, closely set, circular pits, producing an almost reticulate appearance. Valves almost equi-valve although the left valve slightly overlaps the right midventrally. Dorsally the right valve slightly overreaches the left. Internal characters not seen.

Dimensions

HOLOTYPE. Io. 620, carapace (Pl. 15, figs. 19-21), length 0.43 mm.; height 0.20 mm.; width 0.17 mm.

PARATYPE. Io. 621, carapace, length 0.40 mm.; height 0.18 mm.; width 0.13 mm.

REMARKS. A rare ostracod which in general shape closely resembles *Cytherura* (?) *liesbergensis* Oertli (1959a, pl. 4, figs. 112-125) but lacks the sharply differentiated marginal area and median sulcus present in the latter species. The caudal process, common to the genus *Cytherura*, is not represented here, the species being assigned to the genus *Cytheromorpha* which it externally resembles.

VII. REFERENCES

- APOSTOLESKU, V. 1959. Ostracodes du Lias du Bassin de Paris. *Rev. Inst. franç. Pétrole*, Paris, **14** : 795-826, pls. 1-4.
- ARKELL, W. J. 1933. *The Jurassic System in Great Britain*. viii + 681 pp., 41 pls. Oxford.
- 1956. *Jurassic Geology of the World*. xv + 806 pp., 46 pls. Edinburgh.
- BATE, R. H. 1959. The Yons Nab Beds of the Middle Jurassic of the Yorkshire Coast. *Proc. Yorks. Geol. Soc.*, Leeds, **32** : 153-164, pl. 3.
- BIZON, J. J. 1960. Sur quelques ostracodes du Lias du Bassin Parisien. *Rev. Micropaléont.*, Paris, **2** : 203-211, pls. 1-3.

- BLASZYK, J. 1959. Two new bathonian ostracods of the genus *Progonocythere*. *Acta Palaeont. Polon.*, Warszawa, **4**: 431-447, pls. 1-5.
- BRAND, E. 1961. In BRAND, E. & MALZ, H. Drei neue *Procytheridea*-Arten und *Ljubimovella* n.g. aus dem NW-deutschen Bajocien. *Senck. leth.*, Frankfurt a.M., **42**: 157-173, pls. 1, 2.
- 1962. *Fuhrbergiella* n.g. *Senck. leth.*, Frankfurt a.M., **43**: 1-39, pls. 1-6.
- CORYELL, H. N. & FIELDS, S. 1937. A Gatun ostracode fauna from Cativa, Panama. *Amer. Mus. Novit.*, New York, **956**: 1-18, pls. 1, 2.
- CORYELL, H. N., SAMPLE, C. H. & JENNINGS, P. H. 1935. *Bairdoppilata*, a new genus of Ostracoda, with two new species. *Amer. Mus. Novit.*, New York, **777**: 1-5, pl. 1.
- EVANS, W. D. 1952. The Jurassic Rocks of the Lincoln District. *Proc. Geol. Ass. Lond.*, **63**: 316-335, pl. 11.
- FERNET, P. 1960. Étude Micropaléontologique du Jurassique du Forage de Saint-Félix (Charente). *Rev. Micropaléont.*, Paris, **3**: 19-30, pls. 1, 2.
- GOCHT, H. & GOERLICH, F. 1957. Reste des Chitin-Skelettes in fossilen Ostracoden-Gehäusen. *Geol. Jb.*, Hannover, **73**: 205-214, pl. 14.
- HANAI, T. 1959a. Studies on the Ostracoda from Japan. IV. Family *Cytherideidae* Sars, 1925. *J. Fac. Sci. Tokyo Univ.*, **11**: 291-308, pls. 16-18.
- 1959b. Studies on the Ostracoda from Japan. V. Subfamily *Cytherinae* Dana, 1852 (Emend.). *J. Fac. Sci. Tokyo Univ.*, **11**: 409-418, pl. 28.
- HOWE, H. V. 1955. Handbook of Ostracod Taxonomy. *Univ. Stud. La., Physical Sci. Ser.*, **1**: 389 pp. Baton Rouge.
- JONES, T. R. 1884. Notes on the Foraminifera and Ostracoda from the deep boring at Richmond. *Quart. J. geol. Soc. Lond.*, **11**: 765-777, pl. 34.
- JONES, T. R. & SHERBORN, C. D. 1888. On some Ostracoda from the Fullers-earth Oolite and Bradford Clay. *Proc. Bath nat. Hist. Fld. Cl.*, **6**: 249-278, pls. 1-5.
- KENT, P. E. & BAKER, F. T. 1937. Ammonites from the Lincolnshire Limestone. *Trans. Lincs. Nat. Un.*, Louth, **9**: 169-170.
- KESLING, R. V. 1956. The Ostracod a neglected little Crustacean. Reprinted from *Turtox News*, Chicago, **34**, 4-6: 10 pp.
- KHABAROVA, T. N. 1955. Ostracodes from the Middle Jurassic deposits of the Saratov district and from the northern part of the Stalingrad district. *Trud. vses. nef't-nauch. issled. geol. Inst. (VNIGRI.)*, Leningrad (n.s.) **84**: 191-197, pl. 1. [In Russian.]
- KLINGER, W. & NEUWEILER, F. 1959. Leitende Ostracoden aus dem deutschen Lias β . *Geol. Jb.*, Hannover, **76**: 373-410, pls. 13-18.
- KOLLMANN, K. 1960. *Cytherideinae* und *Schlulderideinae* n. subfam. (Ostracoda) aus dem Neogen des östlichen Österreich. *Mitt. geol. Ges. Wien*, **51**: 89-195, pls. 1-21.
- LJUBIMOVA, P. S. 1955. Ostracodes of the Mesozoic deposits of the Volga-Ural region. *Trud. vses. nef't-nauch. issled. geol. Inst. (VNIGRI.)*, Leningrad (n.s.) **84**: 3-189, pls. 1-13. [In Russian.]
- 1956a. Ostracodes of the Cretaceous deposits of the eastern part of the Mongolian National Republic and their significance in stratigraphy. *Trud. vses. nef't-nauch. issled. geol. Inst. (VNIGRI.)*, Leningrad (n.s.) **93**: 3-174, pls. 1-25. [In Russian.]
- 1956b. Triassic and Jurassic ostracodes of the eastern district of the Ukrain. In Microfauna of the U.S.S.R., **8**. *Trud. vses. nef't-nauch. issled. geol. Inst. (VNIGRI.)*, Leningrad (n.s.) **98**: 533-589, pls. 1-3. [In Russian.]
- LJUBIMOVA, P. S., GUHA, D. K. & MOHAN, M. 1960. Ostracoda of Jurassic and Tertiary deposits from Kutch and Rajasthan (Jaisalmer) India. *Bull. geol. Soc. India*, Calcutta, **22**: 1-61, pls. 1-4.
- LORANGER, D. M. 1955. Palaeogeography of some Jurassic microfossil zones in the south half of the western Canada basin. *Proc. Geol. Ass. Canada*, Toronto, **7**: 31-60, pls. 1-12.
- LUTZE, G. F. 1960. Zur Stratigraphie und Paläontologie des Callovien und Oxfordien in Nordwest-Deutschland. *Geol. Jb.*, Hannover, **77**: 391-532, pls. 26-46.

- MALZ, H. 1958. *Nodophthalmocythere* n. gen. (Ostrac., Ob. Jura), nebst einer Abgrenzung gegen ähnliche Gattungen. *Senck. leth.*, Frankfurt a.M., **39** : 119-133, pls. 1-3.
- 1959. Nomenklatorisches zu einigen Ostracoden-Einheiten. *Senck. leth.*, Frankfurt a.M., **40** : 409-413.
- 1961. Erörterung der taxonomischen Fassung der *Prognocytherinae* (Ostracoda). *Senck. leth.*, Frankfurt a.M., **42** : 175-179.
- MANDELSTAM, M. I. 1959. Ostracodes of the Palaeogene deposits of Central Asia. In *Microfauna of the U.S.S.R.*, **10**. *Trud. vses. nef.-nauch. issled. geol. Inst. (VNIGRI)*, Leningrad (n.s.) **136** : 442-543, pls. 1-9. [In Russian.]
- 1960. In ORLOV, J. A. (editor), *Fundamentals of Palaeontology* [8] *Arthropoda, Trilobita and Crustacea*. 515 pp., 17 pls. Moscow. [In Russian.]
- MARTIN, G. P. R. 1960. In HOFFMANN, K. & MARTIN, G. P. R. Die Zone des *Dactylioceras tenuicostatum* (Toarcien, Lias) in NW- und SW-Deutschland. *Paläont. Z.*, Berlin, **34** : 103-149, pls. 8-12.
- MERTENS, E. 1956. Zur Grenzziehung Alb/Cenoman in Nordwestdeutschland mit Hilfe von Ostracoden. *Geol. Jb.*, Hannover, **72** : 173-230, pls. 8-14.
- 1958. Zur Kenntnis der Ordnung Ostracoda (Crustacea). *Geol. Jb.*, Hannover, **75** : 311-318, pls. 6-16.
- MOORE, R. C. 1961 (editor). *Treatise on Invertebrate Paleontology*, Pt. Q., *Arthropoda*, **3**. xxiii + 442 pp., 334 figs. Kansas.
- OERTLI, H. J. 1956. Ostrakoden aus der oligozänen und miozänen Molasse der Schweiz. *Abh. schweiz. paläont. Ges.*, Basel, **74** : 1-119, pls. 1-16.
- 1957. Ostracodes du Jurassique Supérieur du Bassin de Paris (Sondage Vernon 1). *Rev. Inst. franç. Pétrole*, Paris, **12** : 647-695, pls. 1-7.
- 1958. Les Ostracodes de l'Aptien-Albien d'Apt. *Rev. Inst. franç. Pétrole*, Paris, **13** : 1499-1537, pls. 1-9.
- 1959a. Malm-Ostrakoden aus dem schweizerischen Juragebirge. *Denkschr. schweiz. naturf. Ges.*, Zurich, **83** : 1-44, pls. 1-7.
- 1959b. Les Ostracodes du Bathonien du Boulonnais. 1. Les "Micro-Ostracodes". *Rev. Micropaléont.*, Paris, **2** : 115-126, pls. 1-3.
- 1960. *Procytheridea parva*, new name for *Procytheridea minuta* Oertli, 1959. *Rev. Micropaléont.*, Paris, **3** : 70.
- PETERSON, J. A. 1954. Jurassic Ostracoda from the "Lower Sundance" and Rierdon formation, Western Interior United States. *J. Paleont.*, Chicago, **28** : 153-176, pls. 17-19.
- POKORNY, V. 1957. The phylomorphogeny of the hinge in Podocopida (Ostracoda, Crustacea) and its bearing on the taxonomy. *Acta Univ. Carolinae, Praha*, **3**, *Geologica* : 1-20, 4 figs.
- 1958. *Grundzüge der zoologischen Micropaläontologie*, **2**. VEB Deutscher Verlag der Wissenschaften (Ostracodes : 66-322, 375-402), 433 figs. Berlin.
- REYMENT, R. A. 1960. Studies on Nigerian Upper Cretaceous and Lower Tertiary Ostracoda Pt. 1 : Senonian and Maestrichtian Ostracoda. *Stockh. Contr. Geol.*, **7** : 1-235, pls. 1-23.
- SWAIN, F. M. 1952. Ostracoda from wells in North Carolina. *Prof. Pap. U.S. geol. Surv.*, Washington, **234**, B : 59-95, pls. 8, 9.
- SWAIN, F. M. & PETERSON, J. A. 1952. Ostracodes from the upper part of the Sundance formation of South Dakota, Wyoming, and Southern Montana. *Prof. Pap. U.S. geol. Surv.*, Washington, **243**, A : 1-18, pls. 1, 2.
- SWARTZ, F. M. & SWAIN, F. M. 1946. Ostracoda from the Upper Jurassic Cotton Valley group of Louisiana and Arkansas. *J. Paleont.*, Chicago, **20** : 362-373, pls. 52, 53.
- SYLVESTER-BRADLEY, P. C. 1948a. Bathonian ostracods from the Boueti Bed of Langton Herring, Dorset. *Geol. Mag., Lond.*, **85** : 185-204, pls. 12-15.
- 1948b. The ostracode genus *Cythereis*. *J. Paleont.*, Chicago, **22** : 792-797, pl. 122.
- 1950. The shell of the ostracod genus *Bairdia*. *Ann. Mag. Nat. Hist.*, London (12) **3** : 751-756.
- 1956. The structure, evolution and nomenclature of the ostracod hinge. *Bull. Brit. Mus. (Nat. Hist.) Geol.*, London, **3** : 1-21, pls. 1-4.

- TRIEBEL, E. 1938a. Ostracoden-Untersuchungen, 1. *Protocythere* und *Exophthalmocythere*, zwei neue Ostracoden-Gattungen aus der deutschen Kreide. *Senckenbergiana*, Frankfurt a.M., **20** : 179-199, pls. 1-3.
- 1938b. Die Ostracoden der deutschen Kreide, 2. Die *Cytheridea*-Arten der Unteren Kreide. *Senckenbergiana*, Frankfurt a.M., **20** : 471-501, pls. 1-6.
- 1940. Die Ostracoden der deutschen Kreide, 3. *Cytherideinae* und *Cytherinae* aus der Unteren Kreide. *Senckenbergiana*, Frankfurt a.M., **22** : 160-227, pls. 1-10.
- 1950. *Camptocythere*, eine neue Ostracoden-Gattung aus dem Dogger Norddeutschlands. *Senckenbergiana*, Frankfurt a.M., **31** : 197-208, pls. 1-3.
- 1951. Einige stratigraphisch wertvolle Ostracoden aus dem höheren Dogger Deutschlands. *Abh. senckenb. naturf. Ges.*, Frankfurt a.M., **485** : 87-101, pls. 44-49.
- 1954. Malm-ostracoden mit amphidontem Schloß. *Senck. leth.*, Frankfurt a.M., **35** : 3-16, pls. 1-4.
- TRIEBEL, E. & BARTENSTEIN, H. 1938. Die Ostracoden des deutschen Juras, 1. *Monoceratina*-Arten aus dem Lias und Dogger. *Senckenbergiana*, Frankfurt a.M., **20** : 502-518, pls. 1-3.

EXPLANATION OF PLATES

All specimens illustrated are now in the Department of Palaeontology, British Museum (Natural History). The photographs, taken by the author, are unretouched except where stated. Dark stained ostracods have been treated with silver nitrate solution to bring out surface detail. Photographs of muscle scars and pore canals taken with the specimen immersed in glycerine.